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Firearms in American History: Our rifles

Charles Winthrop Sawyer

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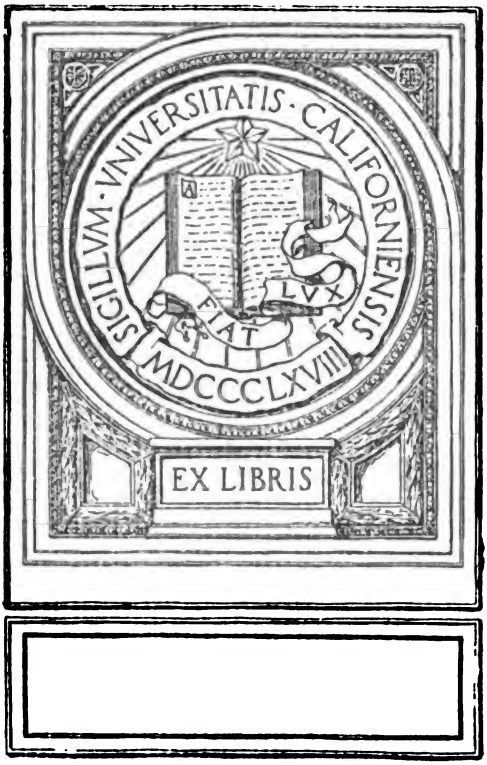

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OUR RIFLES

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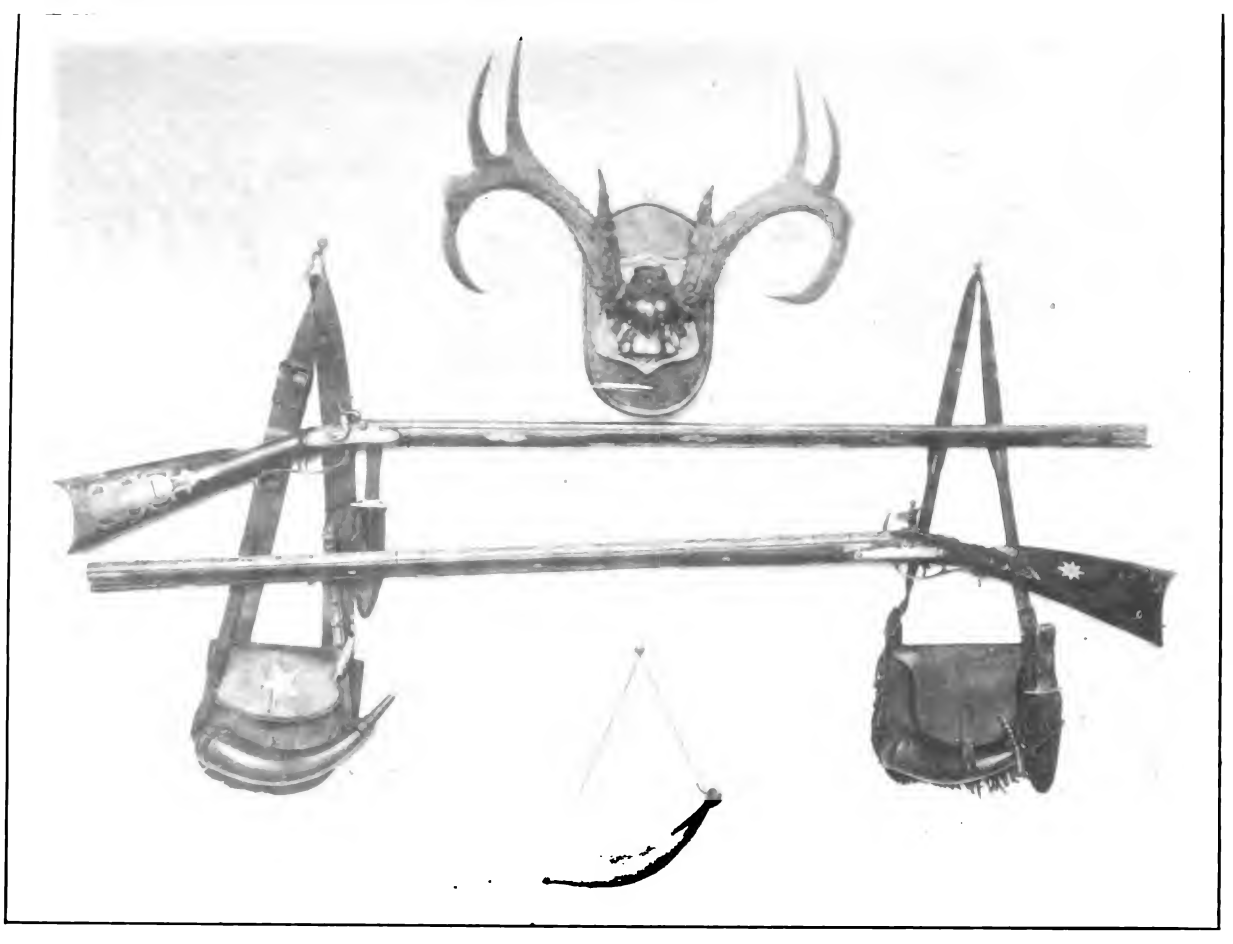

FRONTISPIECE No. 1

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FRONTISPIECE No. 1

OUR SPORTING RIFLES FROM 1800 TO 1840

FOR short range accuracy, flat trajectory, shocking-power and light recoil; for workmanship and ornamentation; for inexpensive ammunition; and last but not least, for the qualities of looks and "feel" that satisfy the lover of arms, these old-timers rival the best modern ones.

These two fine old specimens are in the Clyne Collection and the picture is the contribution of their fortunate owner, Dr. A. C. Clyne of Arkansas. The lower specimen is the older one, and is by N. Beyer of Pennsylvania. Its barrel is 44 inches long and of 80 bore, or 80 balls to the pound. The upper specimen is by Thomas Underwood of Lafayette, Indiana. It also has a 44-inch barrel, but its bore is 150. Both rifles are masterpieces of early American riflemaking.

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FRONTISPIECE NO. 2

THE CHARM OF ARMS IN THE HOME

IN some houses, particularly old ones and those of Colonial type and furnishings, arms displayed in cases each side of doors or windows are appropriate and astonishingly decorative. As masses they diffuse a charm which gives to a room a distinction equalled by no other form of adornment. Examined critically as separate specimens richly compounded of form, color, ornament and workmanship, each contributes such a spice of variety as maintains never-failing interest. Whether regarded individually or in masses they allure by age, beauty, suggestion and sentiment.

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OUR RIFLES

VOLUME III

FIREARMS IN AMERICAN HISTORY SERIES

BY

CHARLES WINTHROP SAWYER

Consulting Engineer Firearms and Ammunition

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OUR RIFLES

Playthings in Peace — Weapons in War

Now comes again the ancient propaganda, spread by a vicious few, of international disarmament and everlasting peace. This pernicious doctrine, as old as nations themselves, and now proclaimed anew on the one hand by those who are educationally or mentally defective and on the other by seekers of gain who are knaves, is dangerous to all nations and especially menacing to the strength, the safety, and even the existence of our own United States.

Books may be filled with the pros and cons. Committees, jurists and international delegates may spend weeks and months in contemplation and argument. After all has been said everything may be rejected as not fundamental except a few basic facts. These are the basic facts:

Belligerent human nature has not changed since Creation. Until human nature becomes divine, and on this earth it never will, certain causes will result in strife between individuals. Until nations become composed of other than just human beings certain causes must result in war. There never will be any value in written-upon-paper

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international agreements not to fight. There is no problem of everlasting peace.

But there is a very real problem of how to be strong in peace; not too strong but just strong enough; not for the purpose of being aggressive but for the sake of being always capable of self-defence and yet a little more. Such a safe condition can be secured in this way:

1st, short-term compulsory military training. This will help to regulate our ever-increasing hoodlum element. It will benefit the physique of the masses. By thoroughly assorting each military unit during the period of training with men of the West, the Middle, and the East of this vast country American citizens will become by association and the averaging of speech and customs and mental attitude better amalgamated Americans than they now are. North, South, East and West must not be strangers with different ideals; intimate association alone will cause all to become patriotic Americans; compulsory military training makes the most patriotic citizens. Then, when comes the critical time for immediate defense, the will to cooperate and the knowledge how will save time and treasure and lives and country.

2d, the maintenance at the highest state of efficiency of a considerable body of detached staff officers. In time of peace they will be divided into groups of specialists who will dominate developments and foresee possibilities in

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warfare adjuncts — communication, arms, tanks, gas, chemical and electrical appurtenances, etc. — and provide sources of their supply to the limit of possible needs. In time of war they will first serve as teachers; in such capacity their value will be inestimable; witness the Second Plattsburg Training Camp for officers, where on the one side the latest knowledge was disseminated by extra competent officers and on the other was assimilated by a large body of college-trained civilians with marvelous speed.

3d, in creating national expertness with the rifle. This is the most important of the three parts of the program. While gas, bacteria and electricity will in the next war be factors of fearful power they will in the beginning of a war be accessories of an attacking army. Our main concern in times of peace is with our means of first defense — that is, with that sort of weapon which can be used from the first instant by the masses of citizen-soldiery with the readiness and certainty with which any man uses his bare hands. There is only one such weapon and that is the rifle. Hence we are nationally vitally concerned with it, and the importance of national expertness in rifle use is paramount.

But rifle expertness, unlike knowledge, cannot be conveyed quickly by an instructor nor be gained by the average man in a short period of intensive training, because to instant and accurate rifle use there is necessary a combination of

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mental and manual dexterity that comes only by long practice. Therefore our weapon of war must become again, as it was in the days of our ancestors, our plaything in peace.

Rifles as sporting arms always did and still do fascinate many men: they must interest us all if we are to continue our present national life. Of themselves alone they possess uncommon charm. In all the world they are the only instruments of precision which formerly were and can again be works of art, studied for form as carefully as a statue, for masses and disposition of color as a picture, for appropriateness of appearance to purpose as a Parthenon, and at the same time for exactness as an electro-micrometer. They used to be the only tools that required the combination of the crafts of workers in many materials: they used to be and they will again be art and engineering products in one.

Rifled arms are the delight of mathematicians and scientists, affording never ending allurement in the attempt to make them do what they often fail to do and yet are theoretically capable of doing. Rifles are the average man's Aladdin's lamp; they bring elating thoughts of out-of-doors, by their appearance suggesting sunshine and cloud-shadows, wooded hills against the sky and watered verdant valleys, wind against tanned cheek and leaping blood and eager chase in wilderness adventure.

A rifle is a stimulator, a companion that brings

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a sense of safety, and a magician that confers wonderful and unlimited power. With it lie life and death; death for him that seeks your life; life, the most precious thing of all, for as long as there is life there is infinite hope, — life for you and your dear ones; and all that goes with life, — home, possessions, friends, family, your chosen kinds of education and religion and government, your nation's existence.

But a rifle's most valuable qualities are for its master. Fired by a poor shot its main worth is to morale; its great powers are at the minimum. In the World War the American soldiers, as a body unskilled marksmen, fired about 7,000 shots for each casualty they produced. It is impossible to insist too strongly that the hit is what counts. In order to be skilled marksmen we must acquire, besides skill at stationary targets with deliberate aim, proficiency at snap-shooting. The man who makes strings of bullseyes on the usual rifle range is a looser at fleeing game and as a soldier is helpless before a running, jumping, dodging charge of enemy infantry. A real rifleman must use his rifle with instant accuracy in the instinctive way that a batsman strikes a flying ball. Range instruction, then, must include snap-shooting by the instinct-method. When a rifleman can make 6 quick hits on a two-foot steel sphere that, starting from a considerable distance comes rolling, bumping and jumping down a long, curved, littered incline, that man is a national asset.

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A plaything in peace, the highest use of the rifle is for defense in war. Once more, without skill in shooting, the arm alone confers little power. It is impossible to insist too strongly that the hit is what counts. It is the plain, brutal hit that gets the sportsman's game and saves the soldier's life. It is the hit that wins battles and saves nations. That plain, brutal hit is more mighty than strategy; more mighty than genius; more mighty than national wealth and advantage in numbers and terrain. It is the hit that counts. Strip warfare of everything but that fundamental and see. Governmental powers behind the armies, — preparedness, organization, coordination, vast resources, military skill, — all depend, to win, upon the life that is in the animated chessmen. Take away that life and all is gone. In battle success is, as an element, as simple as this; — your opponent sends a death-dealing missile at you and misses; you send one at him and put him out of action. Multiply by millions and army instead of individual operations exist. So important is accuracy of fire that if the enemy lacks it and you have it hé is welcome to ten times your strength and all advantages in position and adjuncts, and you win. The sum and the substance of all shooting is that victory is to the best shot with the best arm.

In days before firearms, England was the strongest European nation because of national skill with the long bow. Practice with the long

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bow was by law; it was compulsory; it applied to every man, high and low. And it was not a burden to the nation; it did not greatly interfere with business; on the other hand, it was valued as attractive and healthful recreation. England did not maintain a great standing army, because her citizens, by their skill as archers, were themselves stronger than any foreign army.

In the days of our American ancestors the United States maintained its precarious existence only because every man was a user of arms in time of peace. During the French and Indian Wars, the Revolution, and the War of 1812, Americans were the foremost rifle users of the world. The abundant game that in the times between wars furnished the incentive to shoot is gone forever, but the need for the hobby of arms has come back with redoubled insistence.

America needs government-subsidized rifle practice; regular practice; constant practice; that applies to all men and some women. Apathy will disappear if interest is aroused; sentiment creates interest; the sentiment of arms lies in the lore of arms as told by voice and book.

This book is not for ordnance experts, for it avoids with care the mathematics and the technicalities of the advanced text-book on exterior and interior ballistics. It is for our brothers Tom, Dick and Harry, who form the bulk and the strength of our nation; it is a primer, and a pioneer in the A B C's of rifle sentiment; it is

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humbly offered in the spirit of help and of patriotism. We who form the fraternity of arms users believe that this sort of contribution to the lore of rifles helps to spread the sentiment which may induce all our countrymen to admire and know and use them, for we are sure that a renewed national sentiment for arms will help to make our nation strong and lasting.

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Part I. SPORTING RIFLES

Chapter I

Our Sporting Rifles from 1800 to 1920

Flint Lock

The kind of rifle most in use in America in flint-lock days was called the "Kentucky Rifle." Its origin and development have been told with sufficient detail in Volume 1. Except during the Revolutionary War, when the United States had Kentucky rifles made and issued to troops as military arms, the Kentucky rifle was an all-purpose weapon, the private property of the citizen who used it. But the exigencies of the new and rather helpless government occasionally required the aid of bodies of hardy, wily woodsmen, who could kill a human opponent with every bullet without themselves getting killed. In such times the government called its militia from the central and southern states, and these bodies of men hurried to the scene self-equipped and armed with their own rifles. Kentucky rifles then became military arms. Until 1815 their chief military service was against savages; but in the last battle of the 1812 War they performed a feat unparalleled in history.

In the Battle of New Orleans, January 8, 1815, the American troops were estimated by their leader, General Andrew Jackson, to total about 4,000 men. Of these about 300 were negroes,

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mostly without firearms of any kind; about 600 were La Fitte's pirates, armed with cutlasses and pistols; part of them served the 13 cannon and the rest were for hand-to-hand fighting in case the enemy scaled the breastworks: their influence upon the battle was very small: there were about 500 regulars armed with muskets; at close range they counted for something; and then there were about 500 regulars armed with Model 1800 Rifles, and about 2,100 militia from Kentucky, Tennessee and Louisiana who were the deadly units in that little army.

General Jackson's opponent was General Packenham, a leader of experience and fame; his force was estimated to be about 10,000 veterans of many battles. General Packenham did the attacking; General Jackson's riflemen did the shooting that counted; in about three hours the battle was all over except for burying the dead. General Jackson reported that he had lost 6 men killed and 7 wounded. General Packenham wasn't able to report, but his successor reported the loss of 2,100 men actually killed and wounded. Many of the dead were shot accurately in the center of the forehead; scores had two or more bullet holes in the skull; hundreds were literally riddled with bullet holes. Regardless of all side influences, the astonishing casualties were the result of accurate shooting.

It was the first large battle between the smooth bore and the rifle. Europe was amazed at it.

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Napoleon, in exile upon Elba, refused to credit the report unless he could see specimens of American sharpshooters, their arms and marksmanship; and several of the victors of New Orleans actually started for Elba to demonstrate their skill. But the Hundred Days came too soon to permit Napoleon to change his musketeers to riflemen. Who can say———?

In the United States, the Kentucky rifle, used by militia as a military weapon, was of great service in the Spanish and the Indian troubles, in the struggle of Texas for freedom, and in the Mexican War. The Kentucky rifle, in flintlock and in percussion lock, from its infancy about 1750 until the time when the muzzle loader was superseded by the breech loader — and that was more than a century later — was ever true to type. No better all-purpose weapon was ever devised for conditions as they used to be.

Authentic data absolutely determining the shooting qualities of Kentucky rifles are now extremely difficult if not impossible to find. But we can safely assume that, although not made by scientists, they were nevertheless short range instruments of great precision.

From their infancy to about 1820 their calibre averaged about .54, for a half ounce ball. From then to the Civil War the small bore "squirrel rifle," using from 90 to 200 balls to the pound, was much in use in rural districts where small game predominated. During the whole period

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fixed sights were the rule, exceptions being most infrequent.

Because "Kaintucks" were accurate within sporting range — about 100 yards — they were said to shoot pointblank. Consequently, fixed sights and very low trajectory to 100 yards with spherical bullet, meant high rear sight and high velocity. High sight, although it may look low, is easily proved. Fix a Kentucky rifle barrel, with breech pin removed, in a vise, and sight it at the crossing of thin lines at right angles placed 50 yards away. On the vertical line measure up from the crossing, and mark the distance between the axis of the bore and the tip of the front sight. Then sight through the bore and have an attendant spot on the vertical line where the barrel points. The fact that this point is above the spot made to show the height of the front sight proves that the barrel is sighted high.

High velocity (for the kind of projectile), ranging from 1,600 to 2,500 foot seconds, is indicated by the quantity of powder held by the charger for the rifle; and again, and as conclusively, shown by the slow pitch of the rifling, which with low velocity would not shoot even a spherical bullet accurately.

Hence at anything under 100 yards the aim was correct within an inch or so with the same sight; and consequently it made no difference whether the savage peeking over a fallen log, or the squirrel squatting on a branch, was 20, 50,

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or 90 yards away; if he was truly covered, down he went.

The average backwoodsman used the same charge always, regardless of distance or kind of game, and got to know just what his rifle ought to do at all distances. He knew how much to aim under a small object near him, and how much to aim above a distant one. His rifle was reliable because he never varied the charge.

But an occasional genius proved the rule by making exceptions. It is recorded that our Robin Hood, yclept Dan'l Boone, used to strain his "Old Betsey" occasionally with six fingers of powder in the barrel, thereby getting up a speed to his bullet of about 2,500 feet to the second, and shocking some distant redskin who was making insulting motions from far beyond what he supposed to be rifle range. And, on the other hand, Dan'l, when a prisoner of the Indians, was obliged to practice economy to the extent of using half of a small powder charge, and half of a bullet cut in two with his hunting-knife, so as to lay by a supply for the days of escape. According to history Daniel brought home the venison just the same.

With the Kentucky rifle the spherical bullet also went out of use. At short ranges its target qualities are up to the rifle crank's heart's desire; and, also at short ranges, its game-getting qualities far exceed those of the pointed bullet. Not for a minute is the ball advocated as a long range competitor of the

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sharp pointed bolt shot from a high power modern rifle; but at a hundred yards, or less, or a little more, it has points of superiority. While a small calibre sharp pointed soft nose bullet frequently acts upon live meat like the thrust of a slender dagger, drawing little blood and often producing but little inconvenience, at any rate at the time, on the other hand the stunning blow of the blunt ball, even when wrongly placed, instantly and almost invariably disables either man or beast. It might be well to revive its use.

And why not, in these days of scarce game, and also of interest in target shooting, resurrect also the Kentucky? The sport of archery, a revival or survival of the serious use of the bow and arrow, hasn't half the fascination of rifle shooting, yet has a host of followers. Bows and arrows are mere sticks. But a fine Kentucky is the acme of grace, color, and lavish ornamentation. A high-grade hand-made reproduction of a Kentucky would cost $400 or more. But there is joy in the mere thought of a Kentucky Rifle Club; the fringed, colorful, picturesque clothing of both men and women; the many adjuncts and accoutrements, worn on the person, delightfully mysterious and important looking; the long, slender, flashing, richly inlaid rifles; the nature-setting of meadow, and trees, and sky. Pleasure, wealth, skill and health.

The eight specimens chosen for illustration represent fairly well the usual forms of butt and the distribution and the average type of ornamentation.

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Before 1800 inserts ran less to conventional forms and more to subjects taken from nature, such as moon and stars, animals, birds, fish, etc.

The woodwork of some of these rifles is beautiful in natural figure and enhanced by artificial enrichment. Usually curly maple of close pattern was chosen, and quarter-sawed — or split — so that the sides instead of the ends of the curls should show. In finishing a stock the wood between the curls was charred soft and then rubbed with loose, fine sand, which left the curls slightly in relief. The wood was then dressed with linseed oil stained with alkanet root and darkened with soot. In a couple of days, when the oil had soaked in but not fully dried, the wood was rubbed long and vigorously with buckskin; this rubbed the stain and soot off the high, hard curls and polished the whole of the wood and left it strongly resembling tortoise shell. The final finish was successive coats of bleached shellac rubbed to a high polish. Pioneers with fixed habitation generally owned two or more rifles; the plain service rifle for use against game and savages and not shellacked and not glittering; and the target shooting or elegantly designed rifle which, in the weekly or even more frequent gatherings of such men whose play was with arms, gratified its owner's self-esteem and in his own opinion at least set his social position, or at least his earning power among his fellows. In these show pieces the mottled wood, plum brown barrel, bright blue lock and trigger, polished brass and silver, made a very pleasing combination. The

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striping of the ramrod, done with blood, or acid, or heat, added one more touch of the picturesque.

Lengths up to six feet were not uncommon, and occasional specimens over that were made either for very tall or very short men. For the latter man loading the rifle was almost a ceremony. Setting the rear sight far forward on the barrel was to minimize the blurr which, when that sort of sight is close to the eye, is troublesome to all shooters and particularly so to those beyond middle life. But the position of the rear sight was also partly determined by another consideration; it was usually set nearly above the point of balance of the rifle when loaded, and marked the spot most convenient for picking up the rifle in a hurry.

Two of the rifles illustrated by Plate 1 are now smooth bores. When new they may have been either grooved or smooth. It was necessary in Kentucky rifle days to have such rifles as were in constant use rebored at least once a year. About 1815 to 1820 the rifle had so long been a satisfactory weapon to the backwoodsman he lost sight of what rifling was for and began reverting to the smooth bore. Many a new rifle, and many a rusted barrel, in that period was ordered made smooth in the belief that it would shoot as well as if rifled and save considerable expense in the labor of cutting. Perhaps it is needless to say that ignorance and economy of that sort were of short duration.

In the pages that follow other flint-lock rifles will be described, — the German and New England

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sporting rifles and the British and American military rifles — which, at one time and another, came into competition with Kentucky rifles and always were "second best." Why? Because the Kentucky barrel was long and burned a large powder charge; heavy for its bullet and caused a minimum of recoil; balanced far forward and kept on the bullseye. Because, using a bullet smaller than the bore and covered with a greased patch, it was loaded easily and quickly compared with other rifles even after becoming considerably foul. Because a Kentucky was an excellent combination target, sporting and military arm having great accuracy, high velocity, low trajectory, maximum shocking power and minimum kick, and other rifles did not possess all of these features. Kentuckies were the first "express" rifles, and better than the later express rifles because the cylindrical bullets of the latter did not give equal results in accuracy.

The Kentucky rifle ultimately developed into the Plains rifle and the Plains rifle into the general use rifle. The Plains rifle began to be developed during the last of the flint lock period and it reached its maturity, whether made flint lock or cap lock, during the percussion period. The change began in St. Louis in the rival shops of the celebrities, H. Hawkins and H. E. Dimick, and was made to meet the conditions incident to life on horseback.

In the flint lock period there was not much variety in ammunition, owing to lack of ballistical knowledge; and there was not the wealth of varied form,

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and mechanical devices for repetition of fire, that arose with improvements in loading and in ignition. Such improvements were barred by the crudity of exploding the powder by a spark obtained by the friction of flint and steel. There was, however, some variety among flint lock rifles.

Plate 1

EIGHT KENTUCKY RIFLES FORMERLY OF THE HAMILTON COLLECTION. NOW IN THE WOODMANSEE COLLECTION. COURTESY OF W. E. HAMILTON

No. 1, Length 63½ inches. Length of barrel 47¾ inches. S. Miller, maker. Curly maple. Brass and silver furniture.

No. 2, Length 59½ inches. Length of barrel 43¼ inches. M. Schull, maker. 80 balls to the pound. Curly maple. Brass and silver furniture.

No. 3, Length 59¼ inches. Length of barrel 44 inches. Joseph Golcher, maker. Curly maple. Brass and German silver.

No. 4, Length 57½ inches. Length of barrel 42 inches. J. J. Henry, maker. 90 balls to the pound. Curly maple. Brass and German silver.

No. 5, Length 56½ inches. Length of barrel 41 inches. M. Smith, maker. Wood seems to be cherry. Brass, silver, and silver wire inlay.

No. 6, Length 58¾ inches. Length of barrel 44 inches. Jacob Rusily, maker. 80 balls to the pound. Curly maple. Solid silver large furniture, silver

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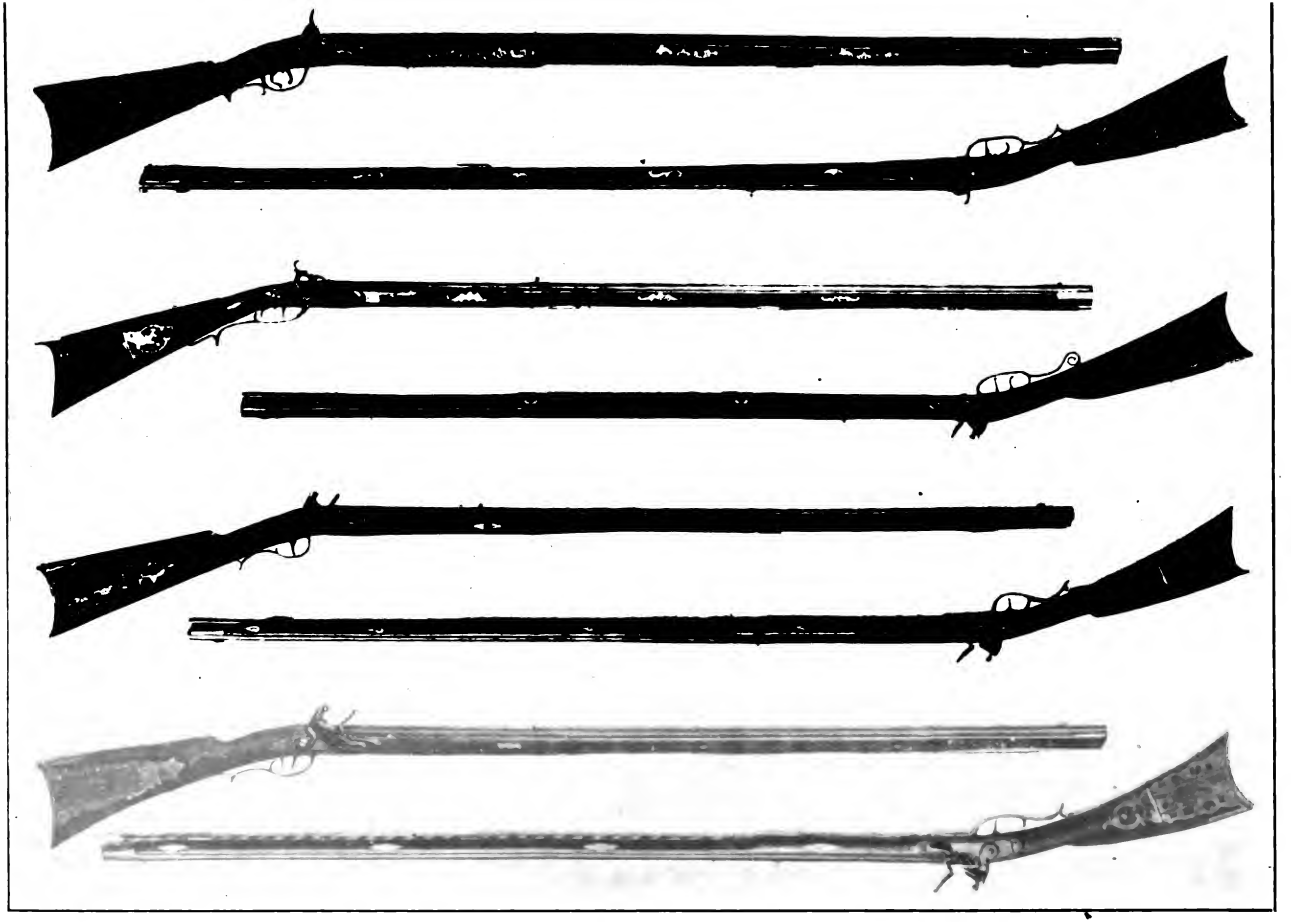

PLATE I, RIGHT

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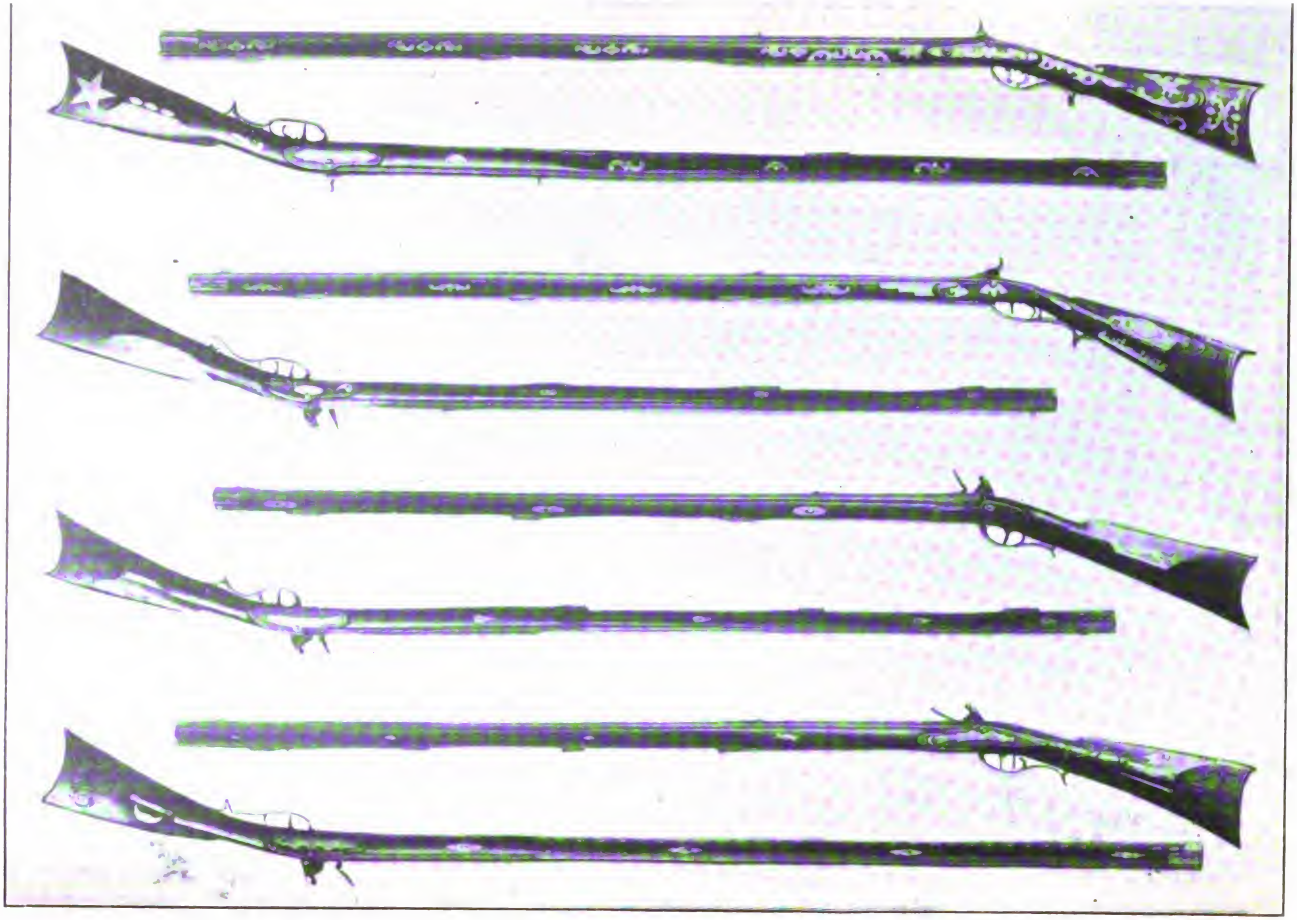

PLATE I, LEFT

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and gold small furniture and inlay. Carving and engraving of admirable quality. Three-leaf-gold trimmed rear sight. The lock, bearing the name S. Spangler, is of an early percussion type which sets the date of manufacture in the vicinity of 1830.

No. 7, Length 61½ inches. Length of barrel 45 inches. J. Bishop, maker. Curly maple. Brass and German silver. 80 balls to the pound. Probably flint lock when new.

No. 8, Length 60¼ inches. Length of barrel 44½ inches. W. Barnhart, maker. Curly maple. Brass large furniture. Silver inlay in barrel and 54 silver inserts in the wood. Rather abundant scroll engraving of good quality. 80 balls to the pound. Formerly flint lock.

Plate 2

No. 1, Very large Kentucky rifle with special rear sight, funnel-shaped, to give clear definition in target-shooting. Although such a monster rifle, six feet and half an inch long, may have been the fit companion of a huge backwoodsman of the Blue Ridge Mountains, it is much more probable that it was made for some keen-eyed, under-sized, five-foot-one, locally famous marksman who bolstered his dignity with purchased inches. Not only was the law of contraries strong in the backwoods, but also humor of a whimsical sort swayed many a man's popularity. The interesting rear sight, adjustable both for wind and distance, undoubtedly is of later

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make than the rifle. Neither lock nor barrel bears the maker's name.

No. 2, Typical New England flint rifle. Period probably about 1800. New England produced but few sporting rifles in the flint-lock period, and those few almost invariably were, in design, based upon that of the German rifles captured by New Englanders at the Battle of Bennington in the Revolutionary War. Compare with the picture of the German rifle shown on Plate 3, No. 2. From just such an arm the Kentucky was developed in the first half of the 18th Century. The conditions of use in New England were quite different from those of the Middle Atlantic and Southern States; hence the development of the rifle in New England was peculiar to itself, and partook of the nature of the fowling piece as far as possible. The barrel of this rifle is surprisingly thin. The calibre is about .50, with eight narrow, deep grooves having a pitch of one turn in ten feet. The total weight is only $7\frac{3}{4}$ pounds; the mountings are of brass and silver, very simply engraved; the patch box opens by pressure on a stud in the butt plate; the sights seem to be copied from those on the German rifle, and are simple and fixed. The maker, Silas Allen of Shrewsbury, Mass., a captain of militia and a gunsmith by trade, lived in the very heart of the region where the captured German rifles were used for the ensuing twenty five or thirty years. The Allen rifle shot a slower ball than a Kentucky and had a far more disconcerting kick.

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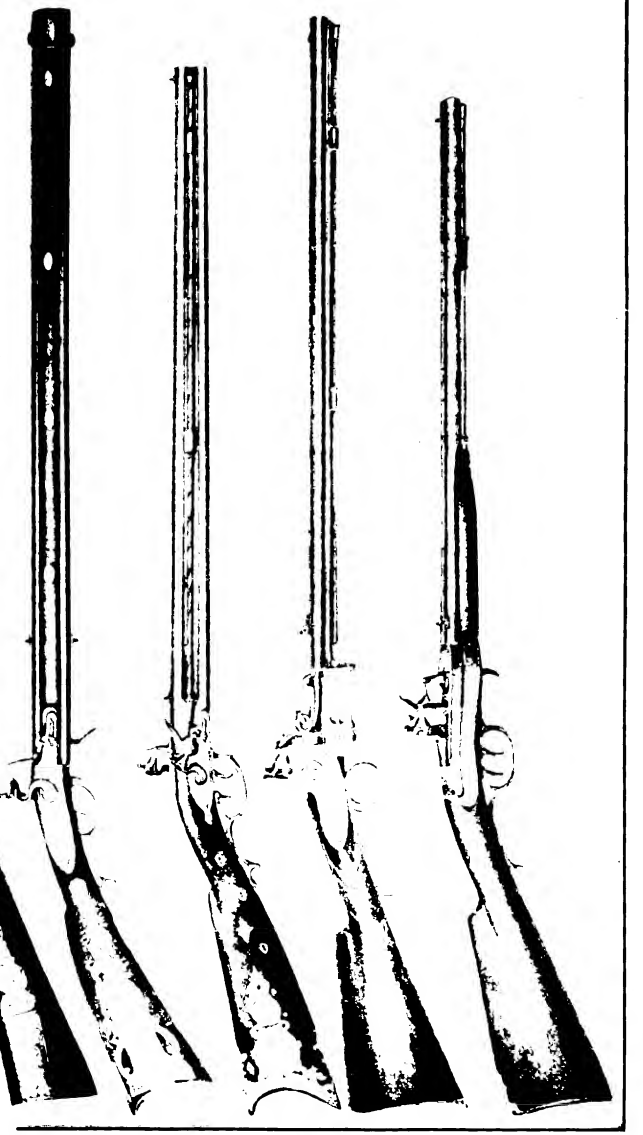

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PLATE 2

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For fifty years or more the repeating rifle has in America held undisputed reign. Few people of the present generation have ever seen or heard of a double barrel rifle, or even thought that such may formerly have been in common use. Yet such was the case, and great numbers were made and used in America even far back in flint lock days.

In volume 1 of the " Firearms in American History " books the tale is told of a shot from a double barrel flint lock rifle that probably was the most important shot ever fired in the United States; for if that bullet had not hit its mark there would not, in all probability, be any United States.

The double barrel flint lock rifle did not originate in America; in crude form it was a common weapon in central Europe as early as 1700; but during the period of the " Kentucky " rifle it was improved and beautified by American artisans to the very utmost possible in a flint lock arm. Almost invariably the barrels were one over the other, both bored in the same piece of solid iron; there was but one lock for both of them; they were pivoted upon a central axis and after the top one was fired the lower one was turned up. Each barrel had its own sights, conforming to its shooting peculiarities; hence accurate shooting could be obtained. In the flint lock period American gunsmiths very, very rarely attempted the difficult, to them practically impossible feat, of making a satisfactory double barrel rifle by brazing together two separate barrels side by side, with one set of sights for both barrels.

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No. 3, Double barrel rifle with one lock and barrels that revolve by hand. Weight about ten pounds. Made by J. Hillegas, of Pottsville, Pa. The lock plate with its internal parts and its cock is set in the butt, and the pan and frizzen of each barrel is fixed to the barrel and turns with it to meet the cock. This type of arm was as often made with one barrel smooth-bored so that ball-and-buck, or bird shot, or bullet, could be used in it. Both barrels are bored in one piece of iron. On the further side of the barrels there is a ramrod. In the filigree work around the patch box there is a spot, or place, where the wood beneath has been cut out and a spring and rod set in; strong pressure with the ball of the thumb on that one small spot causes the cover of the patch box to fly open. Of this device there is not the least indication; and there is no other way to get the cover open; the surrounding metal is not held by screws, which could be removed, but is either bedded in place with an adhesive or else is held by blind pins. This secret receptacle is interesting; was it a safety-deposit box for valuables as well as a patch box?

No. 4, Double barrel rifle with two locks and stationary barrels. In this arm the right hand lock is set lower than the left hand one; usually the reverse was the case. The left hand lock, which fires the upper barrel, has its sear connected with the trigger by means of a loose lever extending rearwards in the wood. The color scheme for this rifle is rather attractive; the silver furniture is set in a

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background of curly wild cherry wood enriched with a stain of alkanet root in linseed oil, and graded, for darkness, by heat from clear wood coals; the locks and triggers when new were blue-black; the barrels were stained plum color by rusting with salt and water, polishing with a scratch brush and washing in a hot, weak solution of bluestone and water; the ramrods, one on each side, are straw color (hickory) striped with red-brown. The fitting and finishing of the parts of the rifle show excellent workmanship, but the design of the inlaid ornamentation is amateurish and weak and shows lack of knowledge of the fundamentals of decorative design. This rifle is a rarely good specimen of isolated backwoods effort, because it shows so plainly, by its careful and accurate workmanship and elaborate finery, the love of the maker for his work, and at the same time it shows so plainly that his failure to express his sentiment was due to lack of culture. The rifle reconstructs the man: plain of face, figure, and the speech of every-day thoughts; kindly, simple, honest and painstaking; shy and repressed in intercourse with his fellows but full, within, of ideals and emotions; a dweller in an isolated and shut-in world where he got nothing from others higher than what he himself developed.

No. 5, Collier revolving breech loading rifle. This invention had little American use, but was of American origin. Elisha H. Collier, of Boston, Mass., developed this breech-loading multi-shot mechanism, suitable for pistols, smooth-bore guns

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and rifles, during the latter part of the 1812 War. The country was financially poor then, and the Collier arms were expensive ones to manufacture; so he soon abandoned the idea of marketing them at home and went to England, where he patented his invention in 1818. From then until 1850, when he returned to Boston, they were made extensively in flint lock, pill lock and cap lock. Their use was confined almost without exception to the tropics — India and Africa — where heat and moisture soon reduced them to ruin; this accounts for the few at present in existence.

For the flint-lock period, this arm represented the last word in advancement; it was as good as the system of ignition would permit. The frizzen is a box containing 10 charges of priming powder, each charge automatically deposited in the flash hole by the movement of the frizzen. In the butt a removable tube contains a store of priming for refilling the magazine of the frizzen. The cylinder contains five chambers (in this rifle; in others from four to eight): the chambers are chamfered at the muzzle and they fit over the rear end of the barrel to make a nearly gas-tight joint. The turning of the cylinder is accomplished by hand; first releasing it by pressure on a stud, then moving it rearward to disconnect it from the barrel, then turning it and moving it forward; in the forward position it is fixed against recoil by an arm with elbow joint. When used with Curtis & Harvey's diamond grain rifle powder — the cleanest and strongest powder contemporary

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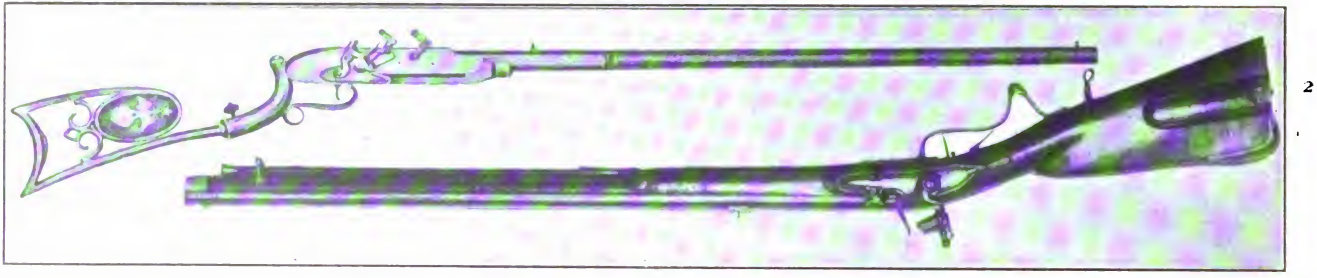

PLATE 3

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with the rifle — Collier revolving rifles were nearly free of jams and misfires, were not unduly noisy like the later Colt rifles, and gave satisfaction as regards accuracy and speed of fire.

No. 6, Hall breech loading double barrel rifle. From 1811 to 1816 the Hall system of breech loading was applied to sporting arms — rifles both single and double, shotguns, and a few pistols. The double barrel rifle illustrated contains all the essential breech loading features of the later Model 1819 U. S. army rifles, the only difference being in the precise form of the individual parts. Its two barrels are bored in one piece of iron; each has its own set of fixed sights. It is shown with the left chamber raised for loading and the right chamber dropped in position for firing. Its length is 4 feet 10½ inches; its weight about 12 pounds. Its probable use was for big game shooting in the wilderness north and east of the town (Yarmouth, Maine), where it was made.

For further data on Hall breech loading rifles, see under Military Rifles, Model 1819.

Plate 3

No. 1, Repeating 3-shot rifle with superposed loads. Each of the loads, placed one on top of the other, has its own flash hole. The forward load is of course to be fired first and the others in succession; this is accomplished by sliding the lock forward, along the groove to which it is fixed, for the first shot, and then sliding it back one space at a time.

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It registers, to each flash hole, by means of the swinging cover to the flash hole, one end of which engages with a notch to locate the lock and hold it. Repetition of fire by means of superposed loads was tried in each stage of firearms development beginning with matchlock and of course never accomplished successfully because of the impossibility of preventing the occasional firing of rear charges by the forward one. The skeleton butt is removable. No maker's marks. See 4-shot repeating pistol, Vol. 1, page 215 and plate 28. See also the Model 1824 Militia Rifle in this volume, Plate 18, No. 6.

No. 2, Captured German rifle, Revolutionary War period and earlier.

This sort of arm, made perhaps about 1770, belongs primarily in the period treated by Volume 1. But in addition it influenced the design of our Model 1800 military rifle, and also the design of sporting rifles made in New England, where the German jägers and their rifles were captured, even up to the period of percussion arms. Moreover, when Great Britain produced her first army rifles this German rifle was the model used, and its bad points were faithfully reproduced.

For an instrument of death, this rifle, when new, appeared decidedly gay and festive. Its light yellow stock, made of maple, close grained and figured, and tipped with ivory, united rather than contrasted with the bright colors of its polished iron barrel and steel lock and its sparkling brass furniture. And its small size made it seem to users of long " Kain-

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tucks" rather like a toy. It was, nevertheless, a hard shooter, although not a very accurate one. Its weight was 7 and ¾ pounds; its whole length was 44½ inches, and the length of its barrel was only 29½ inches. It was intended to shoot a ball of about 19 to the pound (368 grains), loaded bare. The diameter of the ball was .643 of an inch, and as the diameter of the bore plus the depth of two grooves on the opposite ends of a diameter was .635, windage was thus eliminated. In order to get the tight fitting ball to enter the muzzle, the jäger carried, dangling from his belt, a short piece of metal rod and a mallet; with these he hammered the ball in a little way. There was also, dangling from his belt, a stout iron ramrod for driving the ball down onto the powder. When the barrel was dirty, and particularly if the atmosphere was dry, all these aids to loading were really quite necessary; and getting the ball seated often required much time and the expenditure of considerable strength and a great many words.

The use of the metal rods and the mallet soon deformed the inner rim of the muzzle; and when that was the case the accuracy of the rifle was but little superior to that of a musket; but the energy of the tight fitting, misshapen bullet was greater.

The simple, fixed sights seem to be set for 100 yards. This was accomplished by making the bore at the muzzle eccentric with the outside rim of the muzzle; and this in turn was accomplished by belling the barrel at the muzzle externally and then

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filing the top flat to a straight line from breech to muzzle, and seating the muzzle sight into this thin wall.

The pitch of the rifling was one turn in 3 feet; a much quicker spiral than American rifle makers considered necessary, and indicating a moderate powder charge and low speed. There were 8 semi-circular grooves, each 1½ hundredths of an inch deep. These grooves were cut with fair accuracy but not with accurate spacing, hence the lands were of unequal width. Barring this defect, the quality of workmanship, particularly the external fitting and finish, was high.

The large wooden rod carried in the thimbles was a cleaning rod only. There was a cavity in the butt of the rifle in which to keep spare flints; its cover was of wood, and could be removed by sliding it off, rearwards; it was exactly the same as on wheel lock rifles.

In fact, the only material difference between this rifle and its wheel lock predecessors was in the form of the butt and the kind of lock; there had been no real improvement in German rifles for over 200 years. Exactly this sort of arm came to America with the immigrant German gunmakers about 1700, and served as a basis for the development of the Kentucky rifle. All that our government arms makers could find about it worthy of adoption for our first military rifle was the handiness of its short barrel; a case of reversion to first principles.

The German rifle used a large ball, a relatively

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small powder charge, and had, compared with a Kentucky, low velocity, high trajectory, tremendous recoil, limited accurate range, and a far slower rate of fire.

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A national sentiment for arms is of inestimable value. It always was, is now, and always will be.

It may be that the clearest presentation of the former American attitude, or sentiment, toward arms can be given best by a story or two, illustrating conditions during an epoch. The first epoch, terminating with the end of the flint lock period, when only about 3 per cent of the population of the United States lived in cities and less than half of the male white population had educational advantages, is treated by the story of "John Metcalf."

"John Metcalf" was a typical rural American of that time. Practicalities, instinct, affection and hate governed, instead of high intelligence. Such as he composed the raw militia who, under a leader with ability to control him, won the extraordinary Battle of New Orleans. And, chips of the same block, were the later pioneers who won the West from uncountable dangerous beasts and worse savages. He lived in a world-wide age of illiteracy, strong drink, and rough customs. However, merely his sentiment for arms, unshaken by ordeal and passed on to his children, palliates his crudities and sets an example.

JOHN METCALF, OLD-TIME AMERICAN RIFLEMAN[1]

In times of long ago, in the settlement of Wayback, somewhere in New England, there lived a young man whose skill with firearms had wide renown. He lived alone in a one room log cabin in a pleasant clearing on the bank of a small river that formed a highway between scattered settlements; and, had he been asked about his occupation, he would have replied that he was a farmer. But the fruit and the vegetables that he grew in the rich virgin soil of his farm took but a part of his time and furnished even less of his abundance.

[1] Adapted from one of the author's stories in "Romances of a Firearm's Collector."

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The surrounding ancient forest contained quantities of game which offered him both sport and food. And, throughout the length and breadth of the country, there were constant shooting matches, where skill brought both glory and substance. With the terrors of the French and Indian War, and the Revolution, still in mind, all Americans held skill with arms in high esteem.

These shooting matches rarely offered prizes in money. Usually the victor won poultry, pork, lamb or beef; sometimes household goods or other merchandise. But whatever the prize was, it could easily be turned into money, and in consequence John Metcalf not only had an abundant larder but also a stocking, hidden under a hearthstone, which bulged with cash.

At the matches held in Wayback and in the country round about, John Metcalf had a close competitor who was as constant as his shadow. The pair of them were rivals also in suing for the hand and heart of the fair Mary Turner, the greatest prize of all. Neither Metcalf nor Chalfin was able to get a decided answer to his suit. The fact was, both of these young men were average typical Americans, each had pleasing qualities not possessed by the other, and both were equally ardent lovers and would make equally good husbands.

As time went by, Chalfin's success as a marksman increased, thereby reducing Metcalf's supremacy, and, worse yet, his earnings, too. The old saying, "It never rains but it pours," seemed to Metcalf

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really true, for Rumor, too, brought an additional worry; the gossips professed to know that Mary had told in confidence that perhaps the best man would win.

So Metcalf and Chalfin gave even more thought and care to arms. Chalfin scoured and "leaded out" the bore and grooves of his much-worn short and large bore rifle which his father had captured from a German jäger at the Battle of Bennington in the Revolutionary War. For patches he tried various materials tougher and thicker than what he had been using, and he had the nearest blacksmith make for him a die to cut the patches all alike. He polished the ancient weapon inside and out; invented a better rear sight; tested all possible combinations of loads for accuracy; and thought about his rifle, which bore the pet name of "Betsey," and its eccentricities, both day and night.

Metcalf's many guns and one rifle all were old and much worn. The best preserved one was a huge Brown Bess; although a smooth bore and probably incapable of being made to be really accurate, it was in the best condition of any to stand experiments. So he trued its bore by careful reaming; after much musing upon the influence of windage upon a loose ball he found by experiment that a wrapping of thick buckskin glued over the ball, if well done, helped a good deal. He sifted and resifted his powder through muslins of different sized meshes to get the grains of uniform size, and measured a

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large number of charges of powder of similar grain and wrapped them separately for future use.

However, in spite of Metcalf's utmost efforts, his leadership continued to be threatened. His friends chaffed him; and Mary was as coy as usual. Then, one day, he disappeared. A caller found his shutters up, weeds starting in the garden, and the place deserted. Whether or not the fair Mary knew his whereabouts, she kept her own counsel; certainly it was a mystery to all others.

About two months later, an early morning sunbeam, streaming through an open window of Metcalf's cabin, showed John Metcalf upon his bed. Moving along the wall it came upon the polished patch box of a new rifle resting above the fireplace, and lighted the whole room with a myriad of reflections. Metcalf, only half awake, was living over again the adventures of his long journey to Pennsylvania, where were gathered the bulk of all the best rifle-makers of the world. Roused by the glitter, he arose and took down his new treasure. Balancing it, turning it, appreciative of its rich color and beautiful wood-figures, its grace, its tense, alert, high-bred air, he felt well repaid for the time, effort and money spent.

Thenceforth, at every shooting match, he and his new " Mary Jane " were objects of conspicuous attention. No longer was Chalfin a dangerous rival. Neither a musket, a fowling-piece, nor Chalfin's ancient foreign rifle could hold a candle to " Mary Jane " for fine and regular shooting at the usual

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range of ten measured rods. The larder of the little cabin overflowed with the bounty of his harvest. In its secret hiding place under the hearthstone, the long woolen stocking, nearly emptied for " Mary Jane," once more bulged to the bursting point with money saved. John Metcalf was famous and on the road to wealth. Wayback honored him with public office. Mindful of the adage " To him who hath shall be given," he began again to beg his other Mary for the gift of her captious heart and dimpled hand. And, as he shot and won, so he wooed and won.

In those days of long ago when the forest trees grew up to the very borders of the dooryards, ready and waiting to be cut and made into timber, it was customary for every new husband to provide his bride with a brand-new home. And it was customary, moreover, and a jolly and well-liked custom, too, for the neighbors to come from far and near, and settle like a swarm of bees and " give the house " — that is, build it.

Mary and her mother went to live temporarily at John's cabin to prepare, with the help of other women who came by the day, the immense amount of food necessary for so large and hearty a gathering. John, meanwhile, had gone with horse and cart to a distant town for a barrel of rum, for the evils of strong drink were not recognized then.

Upon his return with the rum — and the minister, too, in the same vehicle, — the new house was already under way. Gangs of men, all under con-

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trol of Elijah Chalfin, who had been chosen foreman, were at their various tasks. One gang had cleared and leveled the site for the new house, which was to be a three-room addition to the original one, and had almost finished the small cellar. Another gang was felling trees and chopping them into logs; while still another drew them, with oxen, to the site of the building, cut them into lengths, and notched them. So skilful and hardy were those old-time axmen that one day sufficed for those preliminaries, and at the end of the second day the house was raised and the roof on.

Then organized labor ceased, and each man applied himself to the making of simple furniture and to such finishing touches as his taste and skill permitted. Whereas, before, there had been liberal feeding and frugal drinking, now the rum barrel was set in the midst and all hands indulged themselves freely.

Songs, jokes, horseplay and tomfoolery reigned supreme. "When rum is in, sense is out," says the adage. Chalfin's jokes rubbed Metcalf more and more against the grain. Finally Metcalf, not more than half sober, replied in anger, "Dry up, drat ye! Y'aint no good with gun nor gal!" and Chalfin struck him. Instantly there was a rough-and-tumble fight. The tipsy onlookers took sides and cheered and jeered.

Suddenly Chalfin, with a lucky jerk, tore himself free, and ran toward the porch of the new house, where everybody had left their arms. While Met-

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calf's friends were dusting him off, Chalfin came back with "Betsey" in one hand and "Mary Jane" in the other. A nearly sober ally of Metcalf's assumed charge of the new situation, and, drawing the friends of Metcalf to one side and those of Chalfin to another, formed them into parallel rows only a few feet apart. Between the long rows fifty feet were measured as sufficient for men with nerves in such shaky condition, and the standing places of the duelists were marked with chips of wood. To each principal stepped a second, appointed by the man in charge, who loaded the rifles in the presence of all.

Then the principals, shaky with anger, exertion, and liquor, faced each other, each with his rifle in the hollow of his arm, butt foremost, right hand upon the grip, awaiting the word "Shoot!" "Ready," called the leader, "One, two, three, shoot!" At the word both of the powerful men flung their rifles to a horizontal front with flashing quickness and pressed the triggers instantly. Metcalf's flint fell with a click upon the frizzen but brought no answering spark. From the pan of his opponent's gun came the warning flash of successful ignition. Metcalf dodged, but, obtuse with liquor, he was not quick enough. The great ball, more than an ounce in weight and three quarters of an inch in diameter, struck him in the ribs with paralyzing force, and the duel was over.

Now that the dreadful deed was done those who had clamored for it were sobered. The victim was a strong and healthy man. He was still alive and

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conscious. To their anxious enquiries he answered that the best thing that they could do was to bring the bride and the minister.

In his new house, with his bride beside him, John Metcalf lingered between life and death for many days. Fever and pain made him a constant sufferer. Regrets for his rashness saddened his hope for life. Yet no one of them, nor all together, crowded the rifle from his affections. He had it brought to his bedside, and saw that it was properly cleaned and oiled. Then, becoming childish, he asked to have it hung in front of him by cords from the ceiling, where a flood of sunlight, pouring through the open window, showed it brightest of anything in the room.

Hanging there in space, bright against a dark and airy background, graceful, dainty, richly colored, bejeweled with sparklings from its polished metal furniture, the beautiful rifle awakened hazy, meditative, pleasing mind-pictures.

As he grew stronger, the pictures in his mind became clearer, and one August afternoon when the locusts, singing the harvest song, awakened him, and the cool of approaching dusk revived him, he took Mary's hand in his and told her a little story that he had dreamed.

Mary and he had been wandering quietly among the dim aisles of a strange forest, seeking, without hurry, their home and a new life. They came to the rim of the woods and looked out upon a beautiful, sunny, green glade dotted with islands of verdure.

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The breeze, pleasant with odors of flowers and pungent herbs, brought also the purl of running water. They stepped together out into the sunshine and saw before them a stream which had two branches. Down one of them an Indian was going; he turned, and menaced them. John held up his rifle, and the red man vanished. Up the other came a deer. Again John held up the rifle, but the deer, instead of running away, came to them. Next they discovered a house already built; it was peaceful and homey; flowers grew about it, and busy bees were making honey. From the open door came a troop of children, playing and laughing. The little girls were cute miniatures of Mary, demure and shy as wild things; the little boys carried toy guns and — but here Mary interrupted. "John," said she, "you seem strong in your mind and I guess you have dreamed an omen. I felt bad at first that you thought so much of your rifle when you have me, but it has helped you to get well, and so I don't mind. But, oh! those little boys with guns! The love of guns seems born into you men."

John smiled. "Like best friends," he said gently, "sometimes they hurt, but we stay fond of them. Mary, family, and best friends, is the way of it."

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Chapter II

THE PERCUSSION PERIOD

Sporting Muzzle and Breech Loading Rifles

Cap Lock

In this period interest centers in improvements in firing mechanisms and in advance in the knowledge of the science of exterior ballistics. The latter was due primarily, among civilians, to the increased educational facilities caused by the rapid growth of cities and the consequent multiplication of schools and colleges; among our army officers a desire for scientific accuracy was gained during their four years of hard study as cadets at the West Point Military Academy; the former began in one man's fondness for arms and experiments with arms. His accomplishments were first in date and perhaps also in value as one man's work.

About 1800, in Belhelvie, Scotland, a shooting parson with an inventive turn of mind became greatly interested in the experiments of French chemists to substitute potassium chlorate for potassium nitrate in gunpowder. They were unsuccessful in using one for the other; so his first experiments were along the line of mixing the two for use as a charge in his gun-barrel. Happily his courage was such that he was not deterred by the astonishing consequences from continuing to experiment. While trying detonating powder in the pan of his flint

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shotgun for a priming he discovered that it gave better results when ignited by a blow than by a spark; out of this small beginning all subsequent developments grew.

Several years were spent in developing a gun-lock suitable to this new method of firing a charge of gunpowder; in 1805 one was fixed upon and applied to his fowling-piece. He shot with that gun all of the season of 1805 and took it to London in the spring of 1806 to show to some of his sporting friends.

By the time he received his patent papers in 1807 the news of the discovery and invention had spread far and wide. Hundreds of ingenious minds in Europe and America set to work to simplify or improve the new gun-lock or the fulminating powder. One of the first steps was the formation of the priming powder into small pellets or pills. These could be used in a magazine priming-powder lock without mechanical changes, and in single locks with far greater facility than could loose priming powder. Some of the expensive magazine locks were imported into the United States, but the cheaper form of single-pill lock prevailed.

Meantime the copper cap had been designed, but had not achieved popular use. Many inventors claimed it. Priority, however, seems to rest with Joshua Shaw,[1] an English artist living in this country, who applied in 1814 for a United States patent. Not having been a resident of this country for two years, it was refused. His first caps were made of

[1] Joshua Shaw, b. Belingboro, Lincoln County, England, d. Philadelphia, 1860.

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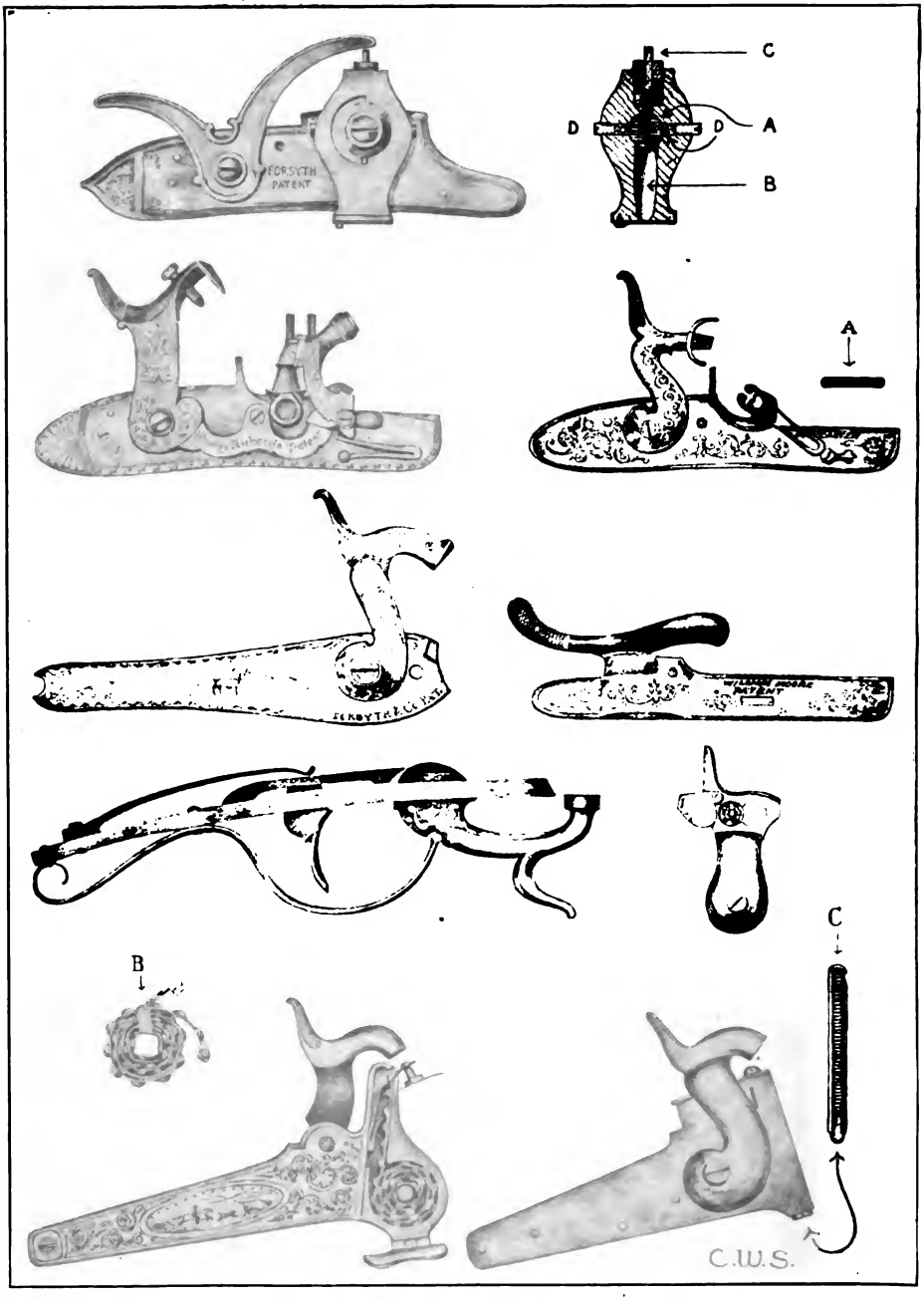

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PLATE 4

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iron, with the idea of repriming them for successive use; in 1815 he made them of pewter, to be thrown away; and in 1816 he made them of copper exactly as they were made for the next fifty years. However, the claims of Roantree, Egg, Hawker and others to its invention had a basis of fact, if not of priority. The device was too obvious not to have been conceived by many minds.

Before the copper cap was universally in use a form of it, called " tube detonator," was designed by Joseph Manton and patented prior to and again during 1818. The tube detonator itself was expensive and it required an expensive lock; its use in America was almost wholly confined to the arms brought by visiting British sportsmen; nevertheless it became an object lesson to American sportsmen of the educated and influential class on the advantages of the percussion system.

Plate 4

No. 1, The original Forsyth percussion magazine-priming lock, patent of 1807. In front of the hammer is a magazine holding forty primings of either powder or pellets. It can be revolved through 180 degrees on a hollow axle; the hole in the axle runs to the chamber. When in the position shown by the picture the lock is primed. After firing, the magazine is to be turned upside down, to spill into place a fresh charge of priming powder or a priming pill.

The section drawing of the magazine, at the right

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of the picture of the lock, helps to explain the simple mechanism. A is the hollow axle communicating with the chamber of the rifle, on which the magazine turns. B is the cavity for the storing of priming powder or pills; it is covered by a thin lid lightly pivoted; when the magazine is turned over so that the cavity is uppermost a priming enters the hollow axle through the vertical hole. C is the firing-pin, held away from the priming until the hammer strikes it by a spiral spring. DD are oil-soaked corks for lubricating the axle and preventing the explosion of stray particles of detonating powder by the friction between the magazine and the axle. From this magazine pill lock sprang the pill locks used in America.

No. 2, The Westley Richards automatic-priming percussion magazine lock, patented in 1821, a subpatent to the Forsyth master-patent. The magazine is in the place formerly occupied by a frizzen of a flintlock. When the hammer is raised the magazine is moved by its spring to the position shown, its outlet hole then being over the top of the cone. By turning the vertically projecting handles half way around the charger in the magazine deposits one pill or one charge of detonating powder in the orifice of the cone. When the hammer falls a connecting rod operated by the cam on the hammer moves the magazine forward out of the way. The magazine is intended to be closed on top only by a thin cardboard wad lightly held in place by the touch of screw threads around its edge.

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No. 3, Tube detonator lock, Joseph Manton's patents of 1816, 1817, 1818. The percussion powder is contained in a copper tube about five-eighths of an inch long and three thirty-seconds of an inch in diameter, made solid at one end and open at the other. The percussion powder is held in place and kept dry by a veneer of shellac within the open end of the tube.

The barrel of the gun is as a flint gun barrel, with a flash-hole; the outer eighth inch or so of this hole is of a diameter to admit the open end of the detonator tube.

The lock plate has a pair of spring nippers to hold the tube when its end is thrust into the flash hole of the barrel; and a solid piece of steel, a part of the lock plate, is below the detonator tube to serve as an anvil when the hammer strikes.

The hammer carries a large, semi-circular shield in case the detonator tube bursts and pieces fly. The tube, however, rarely did burst, but, instead, blew away sideways. This was much more convenient to the user of the gun than picking from a nipple a close-sticking exploded cap; on the other hand, the flying empty tube was likely to be an object of considerable interest to any person standing by. However, this kind of firing mechanism was so easy to manipulate that it had a considerable vogue, and only the fact that the copper cap covered the nipple from rain caused the tube detonator to go into the discard. Almost all the tube detonator locks ever made were converted to cap lock. Above the pic-

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ture of the lock, the arrow leading from A indicates the shape and the comparative size of an average detonator-tube.

No. 4, Typical early cap lock. Marked "Forsyth & Co." The name on it correctly indicates its direct connection with the originator of the percussion system. The Reverend Mr. Forsyth, with a partner, Mr. James Watt, famous for improvements of the steam engine, in 1807 opened a place of business at 10 Piccadilly, London, where, under the supervision of a practical gunmaker, Forsyth Patent Arms were manufactured. As soon as the percussion system settled to a copper-cap basis, — about 1820 in Great Britain, — the Forsyth Company developed the back action lock, which differed from the bar lock of flint lock days in having all its works in the rear of the hammer. This type of lock quickly became popular in America, and was extensively in use; the specimen shown was, in a way, the parent of the American ones. But its extreme vogue was comparatively short, owing to the weakening of the grip by cutting away wood there for the lock seat. The bar lock (Nos. 1, 2, and 3 are bar locks) soon regained leadership. The hammer of this Forsyth cap lock contains the usual hollow in its striking end, but is not vented there, as were hammers of later make. The cone for this lock is seated in a recess in the standing breech, the rain drain of which runs backward; after the cap lock had been in use a few years the rain drain was vented forward, which was a more

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logical way, since a gun in the rain is carried muzzle down.

No. 5, Shows a cap lock with the hammer striking sideways. This lock, patented by William Moore of London in (1830?) is supposed to have been the parent of the popular side-lock system so common among New York and Ohio riflemakers in the period between 1840 and 1870. As can be seen by the pictures of American side hammer rifles the principle only was used; both the appearance and the mechanism were entirely changed to suit American requirements.

No. 6, Cap lock, hammer underneath, trigger guard and mainspring combined; peculiar to the northeastern states from about 1835 to about 1860. The lock shown belonged to a very well made rifle. A variant of it had the sear and trigger-leaf connected by a pin; the rear spring rode the sear on an inclined plane and the sear had a loose connection at its rear, so that the movement of the trigger slid the sear horizontally backward out of the full cock bent. In the case of the lock shown the force of the mainspring operated directly against the release of the sear. The majority of all the American under hammer locks were simpler and cheaper; they were provided with flat mainspring bedded in the wood of the grip and were not provided with trigger guard. (See Plate 6, No. 8, and Plate 9, No. 6.)

No. 7, Cap and tape lock. Coexistent with the copper cap were many other percussion primers, the chief of which, in America, besides the pill, were

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the tape primer and the disc primer. Usually these were in a magazine provided for them in the lock plate, and were adjuncts to the copper cap. The tape priming mechanism most used in this country was the invention of Dr. Edward Maynard, an ingenious dental surgeon of Washington, D. C., who patented it in 1845. The picture shows a typical sporting rifle lock using either tape primers or copper caps. Below B a coil of tape primers is shown; there are 50 pellets in the coil.

No. 8, Shows the tape priming magazine located in the hammer instead of in the lock plate. This was Lieutenant J. N. Ward's patent of 1856. A spur on the left side of the hammer, engaging with an adjunct to the lock plate, operates the device for feeding the tape. Means is provided for cutting off a pellet with each falling of the hammer. This device proved unpopular.

No. 9, Cap and disc primer lock. This lock was the combined invention of Christian Sharps, whose patent was in 1852, and his master armorer, R. S. Lawrence, whose patent was in 1857. A tube of discs is shown under C. The tube is to be inserted in the opening reached by removing the screw in the bottom of the lock plate, indicated by the bent double pointed arrow. A spring within the opening then pushed the whole body of discs upward, so that a finger, operated by the hammer, could slide off the top one and feed it to the cone. When the priming magazine was empty, copper caps could be used.

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PLATE 5

Here may be seen at a glance the salient features of American rifles of the percussion period, from pill lock to breech loading cap lock (revolving breech), and the shapes and the varieties of ornamentation which were most popular during that period.

No. 1, Pill lock rifle; the usual single shot type, altered from a Kentucky flintlock. In place of the pan there is an iron bowl, and in place of the cock there is a hammer with a knob to go down into the bowl.

No. 2, Repeating pill lock rifle. Formerly the property of General Sam. Houston. Now in the National Museum, Washington, D. C. Five shots to each magazine, and almost instantaneous repetition of filled magazines. The magazine is a rectangular block with 5 chambers; it slides horizontally across the breech of the barrel, actuated by the movement of the hammer. This is an Americanization of the Système Jarré, familiar to students of firearm mechanism.

No. 3, Revolving pill lock rifle. Formerly the property of General M. C. Meigs, and now in the National Museum, Washington, D. C. There are two barrels, the upper, rifled, for the 7 charges in the cylinder, and the lower, a shot barrel on which the cylinder turns, to be fired with a separate lock. This rifle was made about 1840, and contains the essential features of the device patented in 1856 by Dr. Alexandre LeMat, of New Orleans, except that

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the LeMat arms revolved by cocking instead of by hand, and that the LeMat ones operated both shot and rifle barrels with a single lock.

No. 4, Cap lock presentation rifle of General U. S. Grant, now in the National Museum, Washington. The two former rifles represent the beginning of the cap lock period, and this the end, as it was made in 1866, when the period of the metallic cartridge breech loader was officially a year old.

No. 5, Plains rifle, about .38 calibre, size, shape and ornamentation all excellent. The reverse side of this rifle, pleasingly ornamented with German silver inlay, is shown by No. 1, Plate 6.

No. 6, Paterson-Colt revolving rifle, period about 1836, the usual type having the operating mechanism geared to the hammer. Silver inlaid.

No. 7, Paterson-Colt, experimental, period 1836 to 1842, revolved by a ringed lever in front of trigger.

No. 8, Paterson-Colt, experimental, revolved by a lever extending downward through a slot in the trigger guard. A large and heavy arm, provided with extra cylinders to be carried loaded. For Paterson-Colt data see Volume 2, pages 15 to 50. These three rifles were in their day considered to be in advance of their time, as the cap lock was still young among sporting arms and the army was still using the flintlock.

Plate 6

No. 1, Plains rifle, early type. Marks erased; probably made by Hawkins about 1835–40. Orna-

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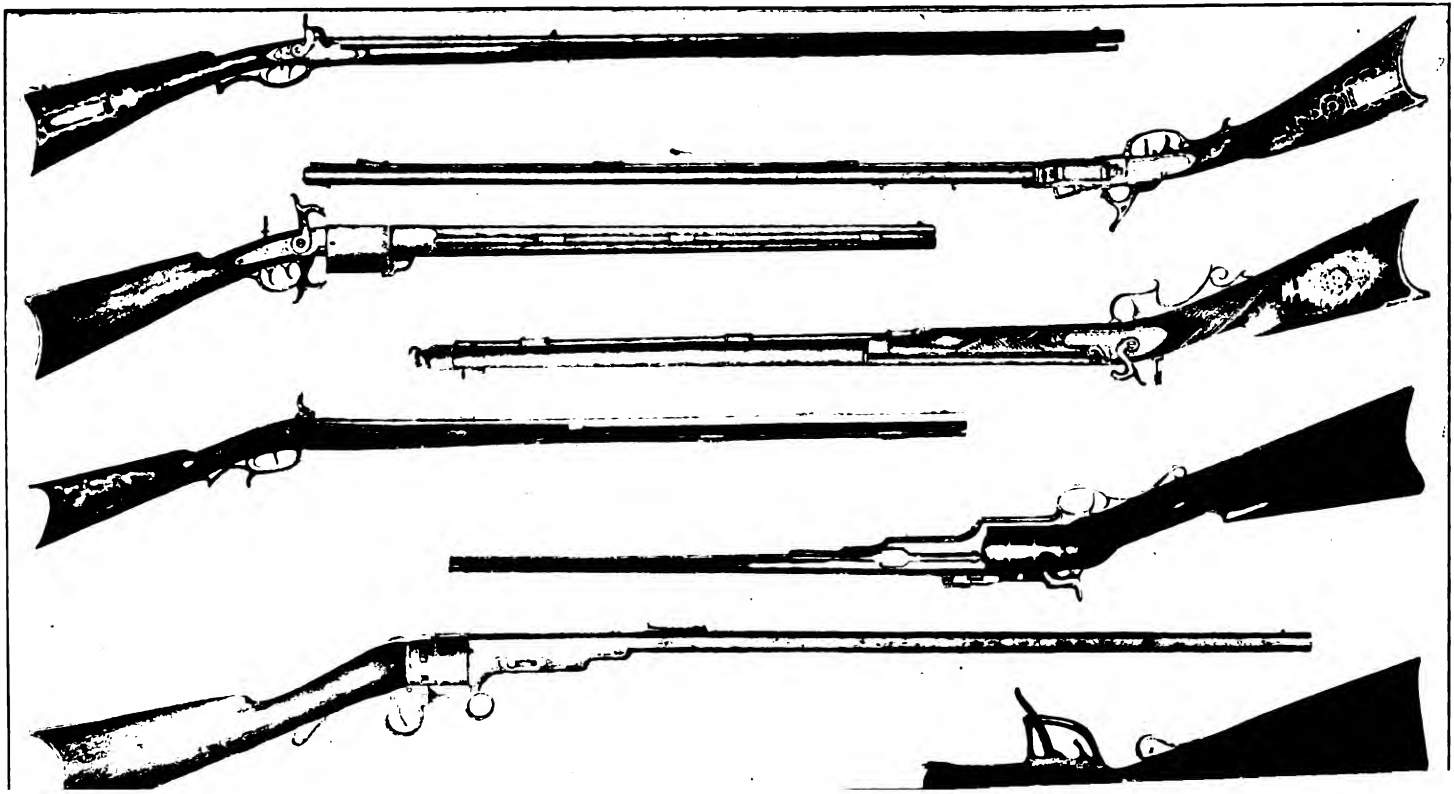

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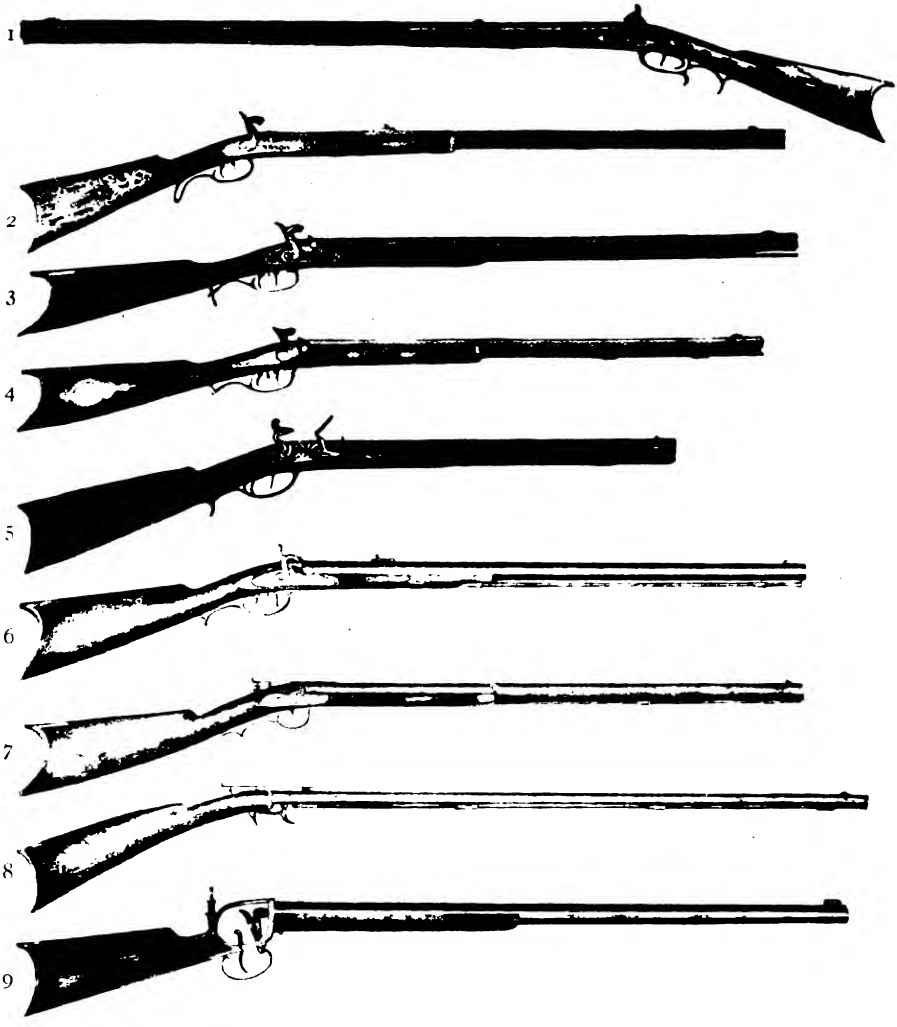

PLATE 6

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mented more than usual. The courtesy is acknowledged of Mr. W. E. Hamilton, for the illustration of this specimen from his collection.

As emigrants moved westward they left behind them the land of hills and valleys, woods and streams, where the seeking of game was done afoot, and entered vast plains where shelter and watering-places were far apart, where they could see game at a great distance, and could themselves be seen from far off both by game and savages. Consequently he who stayed long on the prairies soon learned to live astride a horse. The horseman found that the rifle that had served so well when he was afoot was not now so serviceable; as long as the Kentucky rifle brought from home lasted, the inconvenience of its great length became more and more manifest; when a new rifle became necessary the frontier gunsmith of St. Louis or New Orleans was sure to be ordered not to make it so long as the old one, but to "shorten her up a bit."

Of course the gunsmith shop was a rendezvous not only for those going West but also for those returning East, so that the gunsmith became well informed of the vicissitudes of life on the plains and perceived the peculiar conditions which demanded modifications of the Kentucky. While a gunsmith of considerable ability could at once have met the new requirements of horsemen pioneers with a rifle greatly modified from its prototype, such a new style of arm would no more have met immediate popular favor than did the double express rifles of visiting

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Britons, which were sneered at until they proved their worth again and again. So at first the gunsmith merely did "shorten her up a bit." The result still was a Kentucky, but a slightly abbreviated one. The next step was towards greater handiness by lessening the weight forward. This was accomplished by tapering the barrel and mounting it with a half-stock. Such a rifle was really the first Plains rifle, and is shown by the photograph.

No. 2, Plains rifle, second step in evolution. Period about 1840. Half-stock, considerably lighter forward; somewhat shorter; still retains the excessive drop to the butt. As light an arm as could be fired in rapid succession — as in buffalo-shooting or in repelling a raid by savages — considering the recoil engendered by a half-ounce ball and a large charge of powder. As short as was necessary, considering that the plainsman did not then carry his gun by a saddle-sling or in a boot, but by the grasp of the hand. Not yet free of the shape of a rifle fired with deliberate aim, ignoring the fact that a galloping rider can aim only by instinct, as a batsman uses a bat.

No. 3, Plains rifle, third step in evolution. Period about 1845. Straighter lines than formerly, because in firing from a moving horse it was not necessary to put the face to the comb of the stock; also so that the rifle could be carried conveniently thrust between the saddle and the left leg. A reversion to full stock, so that the deep-seated ramrod thimbles and the absence of a fore end tip would

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minimize wear and tear on saddle and trousers; also so that the smooth lines minimized the danger of sticking fast in place when necessary to draw with a jerk in a desperate hurry.

No. 4, Plains rifle, period 1845–1850. Straightened lines, half-stock, calibre about .50, average weight about 7½ pounds. This type was intended to be carried in front of the right leg, butt end up, in a leather boot which encased the barrel from muzzle to lock. Of course there was no rule governing the manner of carrying the rifle; the plainsman was just as liable as not to carry this sort of rifle always in his hand. In fact this latter way was the safest, because if the habit of carrying the rifle was a fixed one there was no risk, when afoot, of being caught weaponless.

No. 5, Plains rifle, period about 1850. Not flintlock because it was made before the cap lock period, but flintlock because many a middle-aged man was so conservative that he preferred old time styles with their inconveniences to what he superciliously termed "modern contraptions." Bipeds of that type are not yet extinct. In this rifle, size and shape, and not the kind of lock, place its period of make. The influence of the percussion military carbines is so apparent that it is probable that the shop of its maker was located near one of the many army posts which dotted the trails that the Argonauts followed.

No. 6, Typical developed American cap lock sporting rifle, period about 1845 to the metallic

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cartridge period. Our national sporting rifle of the cap lock period was merely a Plains rifle, adapted and perfected for use anywhere by anybody.

The Western gunsmiths who evolved the Plains rifle from the Kentucky held no monopoly on the evolution of a rifle, and the revised size and form, recognized at the very beginning as meritorious for common use, was adopted immediately throughout the United States. The specimen illustrated is an average one, such as was carried in stock by sporting goods stores everywhere. Weights averaged from 6½ to 10 pounds; barrel lengths from 26 to 38 inches; bores from 40 to 200 balls to the pound (about .48 to about .28 calibre); prices ranged according to quality of workmanship and amount of ornamentation from about $35.00 for a plain specimen to $75.00 or a good deal more for a handsome one, in the height of the cap lock period. As late as 1900 a few on hand as left-over stock were catalogued by several sporting goods dealers at the bargain prices of ten to fifteen dollars apiece, including mold, wiper, and canvas cover. The shooting qualities varied from commonplace to excellent.

The illustration is taken from the catalogue issued in 1880 by the sporting goods firm of Turner & Ross of Boston, long ago defunct; and the following is an excerpt from the description in the catalogue: " The Genuine ' Killbuck ' Muzzle-loader. Owing to the popularity of breech loading rifles the call for muzzle loaders is very small, and these have come into our hands at half what they cost to make. The locks

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are front action or bar; the barrels octagon, and the stocks are simply elegant in finish and shape; mountings all brass; set triggers and elegant shooters. We will warrant that every one in the hands of a competent marksman will put 10 balls in succession inside an ordinary playing card at 75 yards, offhand, and 4 out of 5 at 100 yards. We will sell them for $10.00 each, mold included. Satisfaction guaranteed."

From the foregoing it appears that the average rifle of the present day is not more accurate. Also that the Kentucky was not greatly superior at 75 yards. But the ballistical qualities of the developed cap lock rifle were very different from those of the Kentucky. The latter was a one-charge, one-sight, all-purpose rifle: simple. The former was a varying ammunition adjustable sight arm: complex.

No. 7, Side hammer rifle. Although a standard form such as No. 6 fully satisfied the average man there had to be special rifles for exceptional people. In New England, New York, Ohio, and Pennsylvania, locks with side hammer and under hammer achieved considerable popularity. Whether this was due to some peculiarity of the inhabitants of those regions, just as the Kentucky was the outgrowth of the needs of a small community, is a question. But side hammer and under hammer military rifles were even foisted upon the United States army by inventors of the regions of their use as sporting arms; vide the Jenks and the Greene rifles mentioned in Part II.

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No. 8, Under hammer rifle. The lock of this arm is of a simpler and cheaper type than the one shown by No. 6 on Plate 4. It appears to have been developed by D. H. Hilliard, a gunmaker who worked for a third of a century in the village of Cornish, N. H. Mr. Hilliard may have been a man of one idea with uncommon powers of persuasion, for he flooded his territory with guns, rifles, pistols and even muskets for local militia companies, all built with this sort of lock; and, so far as is known, he built no other kind. All these weapons being extremely simple were also very cheap, and gunmakers who worked at a considerable distance were forced by his competition into adopting his designs. The spread of the contagion was, however, confined to New England and eastern New York.

No. 9, Marked "M. Babcock, Charlestown, Mass." Hines Collection; courtesy of Mr. F. E. Hines. The trigger guard is the mainspring. The trigger, projecting upwards through the frame, is also the sear. The hammer is centrally hung, and as the cone is in the axis of the barrel, this is a centre-fire rifle. It is also a take-down; the metal frame and fore end accommodate a series of barrels of varying weights and calibres. Each is held rigidly in place for a short time by a screw extendin through the rear underside of the frame; the on element of successful design which is lacking in the Babcock design is the frailty of connection between stock and barrel. Period about 1860.

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PLATE 7

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PLATE 7

SPECIAL PURPOSE RIFLES

No. 1, American Indian rifle as it looked when new. The picture serves also for a Hudson Bay rifle. From about 1835 to about 1861 the United States Government supplied rifles to its Indian wards, so that they might, according to the statement in their petition, supply themselves with game. Through the Commissioner of Indian Affairs contracts were let to a number of gunmakers, — Leman, Golcher, Deringer, Tryon and others, — and the weapons, as they were delivered to the Department of the Interior, were forwarded to the governors of the western states for distribution. The Indian was permitted his choice of flint or cap lock. The one noteworthy feature of those rifles was their astonishing cheapness, considering that they were strong and safe; the contract prices rarely exceeded $12.00 apiece, yet they were required to endure, before acceptance, a proof charge consisting of 250 grains of the best rifle powder, two wads, and two bullets. Calibres varied from .44 to .80 and barrel lengths from 36 to 42 inches. Each was marked with the name of the contractor.

The Hudson Bay Company first began the sale of muzzle loading rifles in the early part of the metallic cartridge period. In appearance they were like our Indian ones, but were made in Birmingham and bore the Birmingham proof-marks and the HB mark of the company. Many of them had an iron

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instead of a brass patch box, its cover being elliptical and hinged in the centre of its lower edge.

No. 2, American Indian rifle as it looked after use. The savage neglected and abused his rifle, and when its performance was unsatisfactory endeavored to coerce it with a stick or stone, knife or fire. When so foul that he no longer could get a load into it, he immersed it bodily in the nearest water and left it to soak until the next time it was needed. When found nowadays Indian rifles are usually broken in several places and mended with rawhide. The Indian's love of glitter induced him to stud the wood with brass-headed tacks, which he purchased at the agency store; and from white hunters and trappers he got the habit of cutting a nick in the stock for each enemy or head of large game which the rifle killed; and occasionally he carried the ornamentation a step further and nailed his enemy scalp lock to the butt. Not infrequently that "enemy" was the helpless wife or daughter of some emigrant from the civilization which had given him the weapon.

No. 3, Whale rifle. Marked "Brand Arms Company." Made entirely of iron. Bore 1¼ inches. Weight 26 pounds. In front of it is the projectile, made of cast iron bored thin; the breech cap, which has a hole for a fuse, unscrews to permit loading the interior with gunpowder; the outside is rough and is of slightly less diameter than the bore of the rifle; the rings around it are of lead to take the rifling.

No. 4, Marked "Alberston Douglas & Co."

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Made entirely of brass. Weight 35 pounds. The butt is hollow to permit the weight to be still further increased.

One of the most profitable industries of New England from about 1700 to about 1850 was whaling. Towards the latter part of the time whales began to be scarce, and methods of killing them more certain than harpooning were eagerly sought.

At various times during a century and a half whales had been shot with guns of large bore. About 1730 some inventor or whaling skipper had conceived the idea of firing a harpoon from a gun, and whale guns and their missiles received considerable short-lived attention. But the adaptation of gun, line, and harpoon to each other being imperfect, the old method of throwing the harpoon by hand was preferred, and the invention soon fell into disuse.

About 1770, and again in 1817, whale guns were revived by a few enterprising skippers, and by 1820, when improvements had been devised, they were considerably in use, both as shoulder guns and as swivel guns mounted in the bow of a boat.

During all this time it is questionable whether rifled guns were used; in all probability the rifled bore, owing to difficulties in loading, was not in use until whales became so scarce that the loss of one was a serious mishap. By that time, about 1850, not only was the firearms inventor's attention turned to rifles because of their recent adoption for military use in America, but also the missile they

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could use to best advantage, the pointed bomb, had just been invented.

Rifled whale guns to be fired from the shoulder weighed from 18 to 40 pounds, had a bore of an inch or more, and used from 3 to 5 drams of powder. The bomb averaged about 10 inches long, and its weight averaged about a pound. The velocity of the bomb was of course very low, but on account of its great weight and the short distance from which it was fired, it had force to penetrate at least its own length into a whale.

The explosive charge in the bomb was common black powder. It was fired by a slow match, the latter ignited by the flash of the gun. The duration of the slow match was about a half-minute.

Whale rifles were made by a great number of gunsmiths in the coast towns of New England. Those that did the largest business were the Brand Arms Co., of Norwich, Conn.; Alberston, Douglas & Co., of New London, Conn.; Grudchoss & Eggers, and Patrick Cunningham, of New Bedford, Mass.

Some whale rifles were stocked with wood; but the heaviest weight consistent with raising the gun to the shoulder was appreciated by the user on account of the tremendous recoil.

No. 5, Gallery rifle; used a copper cap, a BB shot, and no powder. Eight inches of the barrel, extending from the muzzle back to the notch on the under side, was of the bore to take a BB shot, and rifled. The shot pellet was pushed down from the muzzle with a metal rod. In the notch, concentric

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with the bore, was a cone for a copper cap. From there back to the lock the barrel was thin and hollow and contained a rod, or plunger, the forward end of which struck the cap and the rear end of which was connected to the hammer. When copper caps were at their best this sort of arm gave surprisingly good shooting at fifty feet. As the fulminating powder in the cap rusted the barrel quickly, the eight-inch piece could be removed by unscrewing and a new one substituted. This specimen is stamped "Bandle Gun Co., Cincinnati." The invention is attributed to John Krider of Philadelphia.

No. 6, Buggy rifle. Fixed stock. In the cap lock period country doctors, continually driving over lonely roads, often met game and occasionally a highwayman. They commonly carried a small rifle or a demountable rifle, either in the tray under the buggy seat, or in a holster hung on the dasher. The specimen shown is about .44 calibre, has a 14-inch barrel, a centrally hung underneath hammer, and a trigger guard mainspring which slides along the hammer in cocking and firing; this last feature is unusual. The rifle is just the right size for the buggy seat-tray of the period. Single shot arms of this sort frequently were made with demountable stock, and occasionally with hinged stock.

No. 7, Buggy rifle. Demountable stock. Without the stock this weapon could be used as a revolver. The stock can be fixed instantly to the pistol butt merely by pressing the two together; to take apart, the snap-catch is released by pressing

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with the thumb on the knob. This arm is merely a Wesson & Leavitt revolver with a special butt and a long barrel and a separate stock. It was probably made, and first used, about 1840. Revolving "buggy" rifles from then until the Civil War were favorites with the tin-pedlars; it was a period when the tin-pedlar did a large and profitable business; drove a 2-40 trotter which didn't look the part, and easily won a match with any local speedy road horse; made, won and carried a large amount of ready cash, and sometimes needed a handy multi shot weapon in a hurry.

No. 8, German-American Target Rifle. From about 1855 to about 1875 short range target shooting with rifles made especially for such work was popular among Germans living in New York City. By them many rifle clubs were formed and competitive matches were held frequently. Naturally the rifles used were made in New York City by immigrant German gunsmiths after German models. Such rifles could not be used for quick shooting; moreover, because of their weight, shape, projections, method of loading and peculiar ammunition they were unsuitable both for other kinds of match shooting and for sporting use. Shooting with such rifles was merely a game or pastime and served no high purpose.

The specimen chosen for illustration was made by Rein of N. Y., and is a good average specimen of its type. From this type the recently popular Scheutzen rifles were developed.

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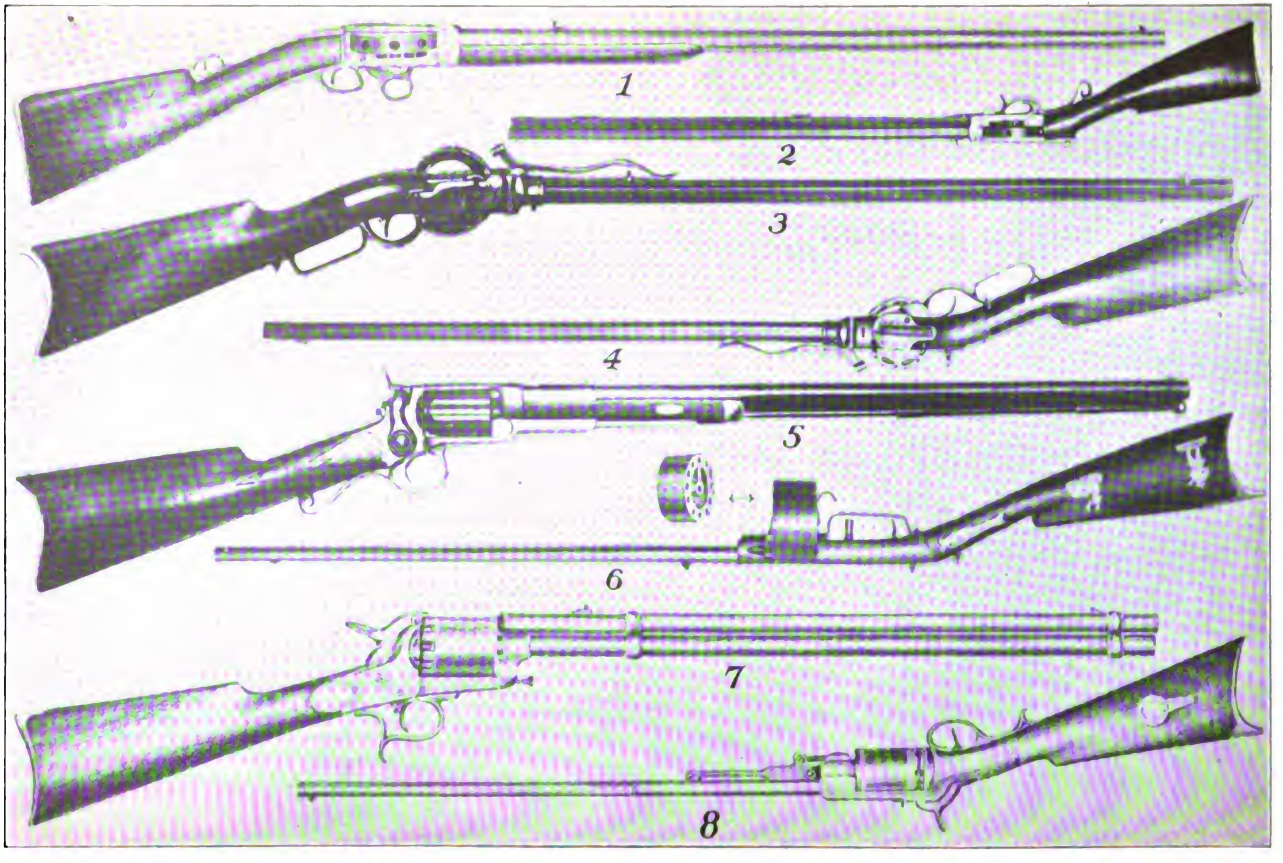

PLATE 8

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Plate 8

No. 1, Cochran rifle. John Webster Cochran's patent of 1837. Eight shots. On account of rearward pointing loaded chambers this device was a dangerous one; many sad accidents occurred with Cochran (and Porter, too) arms, and both in their day were heaped with odium, in spite of which many were made and purchasers for them found. Other inventors recognized the impossibility of using the turret and the wheel movements and avoided them. The turret has now, however, been successfully applied as a magazine (to the Lewis gun), but under quite different conditions.

No. 2, Cochran rifle, nine shots, small size, probably made as a sample for exhibition. In this variety of Cochran the bow of the hammer serves as a guard for the trigger.

No. 3, Porter rifle. Parry W. Porter's patent of 1851. This specimen is made with a magazine pill lock. Nine shots. In the attempt to make this impossible cylinder device a success high grade inventive skill was lavished upon it; under modern conditions some of the principles might be of value to inventors using the wheel principle for a magazine to an air-plane machine rifle.

No. 4, Porter rifle. This specimen uses copper caps.

No. 5, Colt rifle, made at Hartford, Connecticut, perfected Model 1855.

No. 6, Hall rifle.[2] Alexander Hall's patent of

[2] Cook Collection: courtesy of Mr. Charles D. Cook.

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1856. Cylinder releases by pulling the drop-hook; turns by hand. Cocks by drawing front trigger backward. The interesting feature of this arm is the cylinder bearing. Around the rim of the cylinder there are fifteen chambers; within the rim the cylinder is void except for a post which reaches from the inner edge of the rim radially and has at its extremity a hole on the axis of the cylinder. This hole fits over a right angled projection to a post projecting from the under side of the barrel. On the inner surface of the rim there are gear-teeth to be acted on by the mechanism for revolving. Any such odd device may be an inspiration to an inventor of the present day.

No. 7, LeMat rifle. Doctor (later, Colonel) Alexandre François LeMat of New Orleans patented the features of this arm in 1856. A nine shot cylinder for the upper (rifle) barrel turns on a shot barrel. The nose of the hammer is adjustable to serve either barrel.

During the percussion period the most of the arms made on the LeMat system were produced in France and Belgium. Prior to the Civil War those made in Louisiana were shoulder arms for sporting purposes only; during the Civil War the foreign made ones were shipped in considerable numbers to the Confederacy and used by the Confederate armies. After the war LeMat arms using pin fire and early centre fire metallic cartridges were made in almost all countries of Europe but were not popular in America.

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No. 8, Warner rifle. James Warner's patents of 1851, '56 and '57. A simple mechanism interesting on account of the attempt to avoid conflict with Colt patents which covered thoroughly all features necessary to a successful revolver of the copper cap type for a cylinder bored in line with the barrel.

PLATE 9

No. 1, Billinghurst rifle. The revolving, self-priming specimen illustrated was one of many ingenious designs of William Billinghurst, of Rochester, N. Y. As he did not patent his inventions, the date of this arm can only be broadly placed, and lay somewhere between 1850 and 1870.

No. 2, North and Skinner rifle. Patented in 1852. Made by H. S. North, Middletown, Conn. A revolving six-shooter having all functions except loading and firing performed by the movement of the lever in front of the trigger. The attempt at a gas tight joint, by moving the cylinder backward and forward so that it could be free from and then engage with the rearward projection of the breech of the barrel, indicates relationship between this patent and that for the North and Savage revolver.

No. 3, Whittier rifle. Patented in 1837 by O. W. Whittier, of Enfield, N. H. This is the earliest patent for turning a cylinder by means of a stud sliding in grooves in it that has so far been found.

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At a later period it was tried, and abandoned, by Colt; and in recent times it has been revived — and is still in use — for revolving arms made in England and on the continent.

No. 4, Jennings rifle. Patented in 1849 by Lewis Jennings; made by Robbins & Lawrence, of Windsor, Vt. Distributed by C. P. Dixon, agent, located in New York City. Repetition of fire is caused, not from a revolving cylinder, but from a tube below the barrel, holding twenty bullets each loaded with its own explosive propellant.

No. 5, Smith & Wesson rifle; also the illustration serves for a Volcanic rifle, certain specimens of both being identical in appearance. Horace Smith's patent of 1851, improving upon the Jennings rifle by substituting for the ringed, sliding trigger a trigger guard lever; and Smith & Wesson's patent of 1854, improving the mechanism and showing it using a metallic centre-fire cartridge. The latter was not produced commercially, and the Smith & Wesson and Volcanic rifles used self propelled bullets such as the Jennings rifle used. These arms as finally developed became Winchester rifles; see Winchester. Smith & Wesson and Volcanic rifles were the parents, so to speak, of all practical tubular magazine repeating rifles. The Jennings, before them, was hardly practical; the Henry, which followed them, was exactly the same arm adapted to use rim fire metallic cartridges; hence Smith & Wesson and Volcanic rifles can be counted as number one among tubular magazine repeaters.

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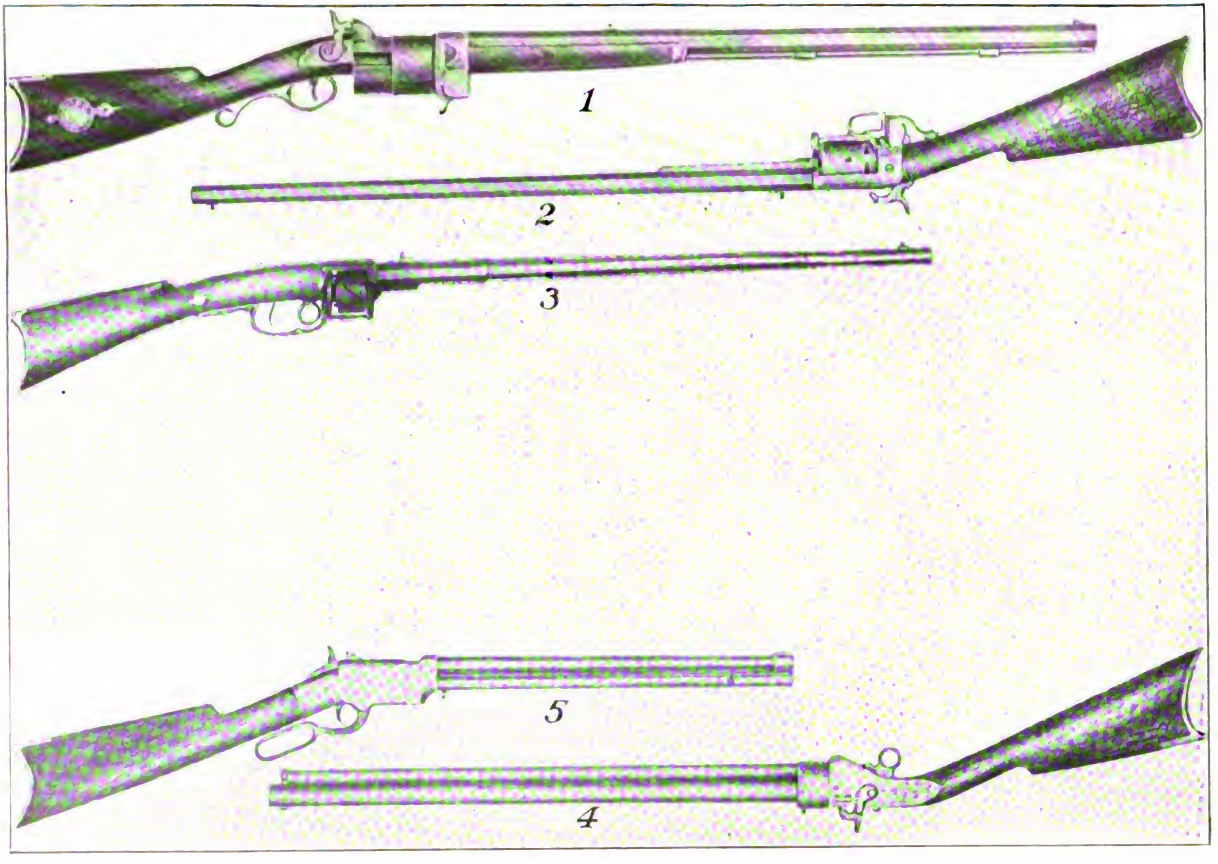

PLATE 9

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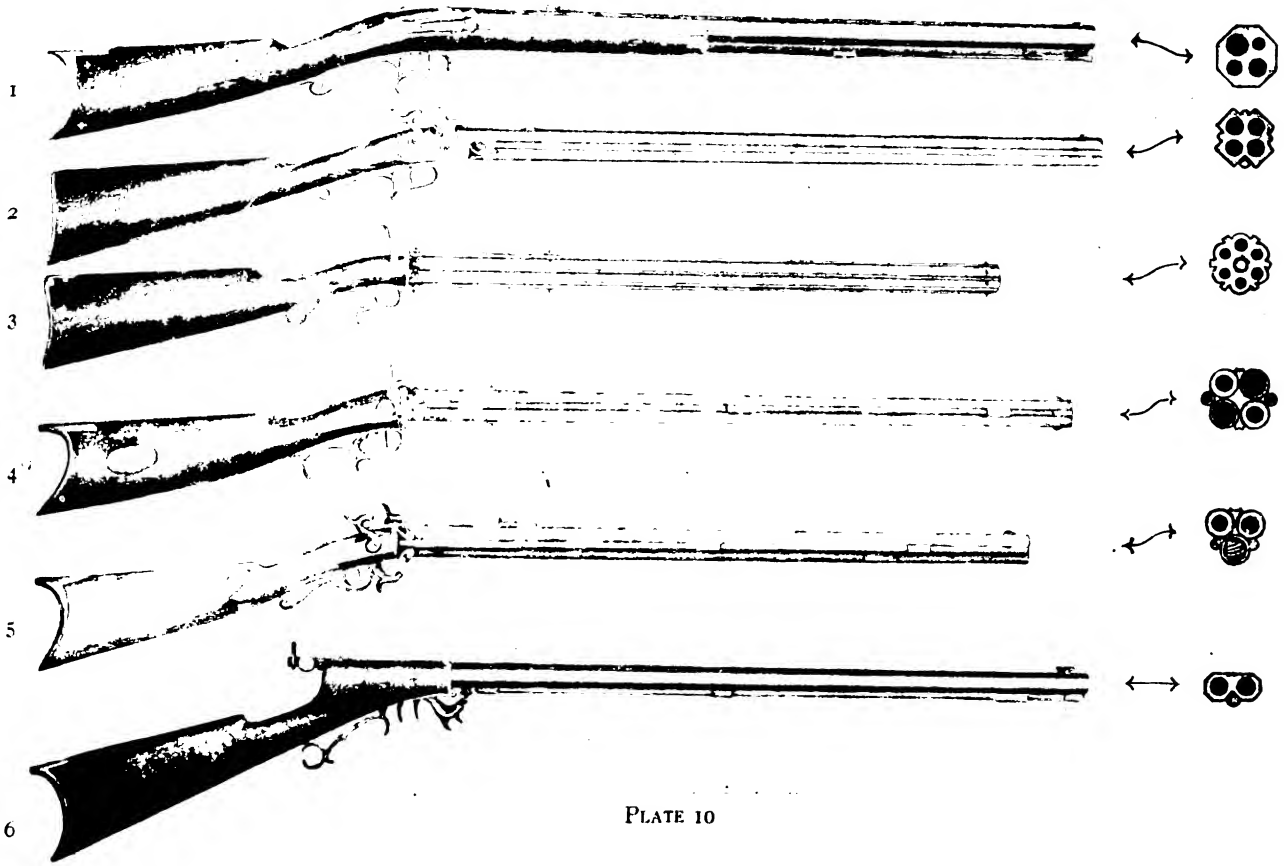

PLATE 10

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Plate 10

No. 1, Pepperbox rifle. Four barrels of different calibres are bored in one piece of iron. There are two lock plates, one on each side, each having two hammers of the mule ear variety. A single trigger throws whichever hammer is cocked; if two or more hammers are cocked at the same time all go at once.

This arm is selected from many of its kind because it combines all their faults. On account of the waste metal between bores the rifle weighs 12½ pounds and has its centre of balance far forward; it is burdensome to carry, unwieldy to manage, and hard to hold on aim. No two of its bores shoot to the same point even at short range, and its large bore could not shoot two or more times rapidly to the same spot on account of the thinness of the outer edge, which, because of unequal heating of the metal, would cause deflection. Yet only one set of sights is provided. The rifle was made about 1855, when pepperbox pistols were in everyday use. The fact that paralleling a set of bores in one piece for a short pistol was a mechanical impossibility should have been a warning to any gunsmith not to attempt the feat on the long barrel of a rifle. Iron and steel at that time were not fuller of flaws, "hards" and "softs" than now, but boring facilities were poorer. At the present time even, with the best materials and tools, and in the most perfect modern vertical boring mill which revolves a single barrel one way

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and the cutter the other, the cutter rarely comes out on centre, and during its progress from one end of the barrel to the other it usually makes for itself a curved path. The barrel straightener remedies the defect, but no barrel straightener ever could by any possibility correct the errors of two or more bores in the same piece of metal.

No. 2, Pepperbox rifle. Four fixed barrels of the same size, each made separately, and so formed on the outside that when brazed together they seem like one piece. The principle of equal distribution of metal was followed with care and this rifle was selected for description because it was the best one available. Nevertheless it could not have been an entirely satisfactory arm, with its one set of sights for all four barrels, because it is improbable that the barrels could be brazed together so as to shoot parallel.

The high and low hammers, one in advance of the other, resemble strongly the design of the Parisian gunmaker LePage, period about 1835; but his use of them in such positions was for superposed loads. The single trigger operates the locks in the succession of upper right, lower right, upper left, and lower left; regardless of the order in which the hammers are cocked the trigger always works the same.

These two rifles cover fairly well the field of the rigid barrel with a multiple of holes and a single set of sights for all. The remaining variety of the pepperbox rifle is the one with turning barrel and a separate set of sights for each bore.

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No. 3, Pepperbox rifle. The picture serves for two varieties, one firing all barrels at once, the other firing singly. First kind: —Six bores grouped around a central one, making seven barrels all bored in one solid piece and all rigidly attached to the stock, and all firing together when the single cap explodes. The calibre of this type of multi-shot rifle rarely was larger than .36 and usually was smaller. The rifle was used for killing large wild fowl (brant, geese and swans), when sitting on water out of fowling-piece range. Second kind: — Six bores in one solid piece; the barrel to be turned by hand on a central axis to bring each bore to the one lock; each bore with its own set of sights. The central chamber held the ramrod. The rear end of this chamber was threaded for a bolt to hold the barrel to the breech plate; the bolt turned with the barrel. In order that the barrel when turned might present each of its six cones correctly to the hammer a stud-lock was provided; it was the same kind common to under-and-over double barrel arms, operated by sliding the trigger guard. The trigger guard, which was movable backward and forward for about half an inch, was held in the forward position by a spring, and in that position a stud, attached to it, entered one of six holes in the breech and locked the barrel so that the bore which then was uppermost could be fired.

This type of multi-shot rifle may have given more practical service than either of the two with the barrel fixed, but it was impossible that all six bores in this barrel gave satisfactory accuracy.

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No. 4, Four barrel combined rifle and shotgun. Barrels to be turned by hand, otherwise held in position by a stud-lock operated with a knob instead of by sliding the trigger guard. One lock, with a swinging arm on the hammer to fire the shot barrel, which is always the lower one. To provide against the accidental firing of both barrels at once, or of one when the other is intended, the swinging arm has a longer reach than the hammer proper. The four barrels are in contact at only four points: — at breech, muzzle, and ramrod thimbles. There are two ramrods, one on each side.

The only unusual feature to this weapon is the means of functioning two barrels with one hammer; guns with four barrels usually were provided with two side locks to fire the barrels that temporarily were uppermost. In this specimen the chance of firing shot for ball is minimized by the necessity of setting the swinging arm. While this gun, like the other pepperbox ones, was made in either Pennsylvania or New York state, its maker's marks are missing, and the chief clue to its identity is furnished by the patch box, identical with such as were on Model 1817 U. S. military rifles. The presumption is fair that the maker was Henry Deringer of Philadelphia, who made both sporting and military rifles, including the Model 1817, which had this sort of patch box.

No. 5, Three barrel combined rifle and shotgun. The barrels are fixed and there is a lock for each. The shot barrel is below; the trigger guard serves as

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a mainspring for its hammer. The usual three barrel rifle or three barrel combination arm had one lock and barrels to be turned by hand to meet it.

No. 6, Double barrel rifle with hammers underneath. Made without trigger guard but with a skeleton pistol grip so designed as to protect the triggers from the rear while the hammers projected enough to guard the front. An oddly designed rifle with no other point of excellence than the shape which brought the peep rear sight close to the eye.

In the cap lock period double barrel rifles were even more popular in America than in the period before. Gunsmiths displayed great ingenuity in fashioning them for various purposes, such as for use on foot and on horseback; for carrying in the hand, in a sheath, or under the seat of a vehicle, and in making inexpensive ones that yet were serviceable. The barrels still were usually placed one above the other; sometimes they were fixed and in other cases they could be turned. One lock and two locks were about equally common; when there was only one lock the hammer was sometimes placed above, sometimes below, and frequently on one side; in this latter case the hammer sometimes had a sliding extension to enable it to reach the lower barrel.

Double barrel rifles made for use in thick woods, in brush or in cane-brakes, where a man hurrying along might be the victim of an accident from, or at least find his progress retarded by, the catching of a hammer or a trigger in the underbrush, were made

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to balance far back, so that the hand carrying the rifle could clasp and protect the lock parts. The hammers of such rifles were as slender and simple as rods, and lay close along the lock plate.

As long as the bore remained unblemished they were, for shooting qualities, unexcelled by any other two-shot rifles made elsewhere in the world. But the American gunsmith, in cap lock days was a poorly paid craftsman, and therefore his work was, with only a few exceptions, poor in wearing qualities, and not of the highest grade artistically. Probably there was no better American rifle maker in his day than William Billinghurst, of Rochester, New York, whose average price for a muzzle loading double rifle was $75.00. Certainly so small a sum could not by any possibility pay for the exercise, upon the bare materials of a rifle, of more than moderate craftsmanship. From the accompanying pictures the crudities of American double rifles are not in every case apparent. Instead of criticising these arms perhaps more help can be given by telling, later on in connection with the Purdey rifle, what constitutes a masterpiece in firearms.

The best double barrel muzzle loading rifles used in America were of British make. Beginning about 1830 many titled British sportsmen visited the United States to shoot the abundant game along the Atlantic seaboard. They purchased American rifles as the most suitable ones for the sport they expected; and double barrel arms appealed to them more than single barrel ones. Those arms they took

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home and showed to their gunmakers; they told of remarkable shots they had made in "The States"; and they proved their tales by shooting at a mark.

The British gunmakers endeavored to reproduce the good qualities of the American rifles and at the same time make them conform to British bias. The Briton was not, as a class, a rifle user, but a shotgun user. So the double rifle which came from the hands of the British gunsmith was a double shotgun in appearance. In the attempt to get accuracy from two separate barrels fastened together side by side and dependent upon one set of sights for both, the Briton had set himself the hardest kind of task. And, in addition, the technicalities of rifle ballistics and manufacture were quite outside of his training. Those early British double rifles were not in the least up to their American prototypes as weapons of precision. But as specimens of handicraft they were better. After about 1840, however, they equalled their American ancestors in the very necessary qualities of hard and straight shooting.

After the Civil War was ended, the mountainous region of northeastern New York was exploited as a hunters' paradise by the writings of "Adirondack" Murray, and the prairies of the Far West, teeming with buffalo and hostile savages, became accessible by the extension of canals and railroads. More wealthy Britons came to "The States" for sport than ever before, and the double rifles they brought with them were masterpieces. They were the handiwork of such famous makers as Purdey, Lancaster,

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Lang, Moore, Henry (of Edinburgh), Daw, Dougall, and Samuel Smith.

Of these men James Purdey stood at the head. As a craftsman he had learned the niceties of the business in the shop of the great Joseph Manton. There, while still a young man, in his speciality of barrel boring he had gained a following sufficient to warrant setting up for himself about 1810. His modest quarters at 4 Princes St., London, soon became a centre of fashion, and were elaborated until, in 1826, as they could be expanded no more, new quarters were taken at 314½ Oxford St. It was while at this latter place that he added to his gun business that of making rifles.

Colonel Peter Hawker, whose judgment upon arms was the fashionable criterion of the times, in his book " Instructions for Young Sportsmen," published in 1846, wrote, " Mr. Purdey has still perhaps the first business in London, and no man better deserves it. While speaking of rifles I must not omit to mention the finest piece of mechanism of the present age, Mr. Purdey's double rifles. The two groove rifles are intended to supersede all others, as I find they are more convenient for loading, because with them you require no mallet to force the ball into the muzzle."

Two years later the celebrated Frank Forester, writing of arms for deer shooting in his " Field Sports," stated in volume 2, page 225: " The best sporting implement of this kind in the world is undoubtedly Purdey's double barrel rifle; and although

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the use of these arms was at first ridiculed by the hunters and trappers of the West, its superior execution and utility are now fully admitted on the prairies, since it has been rendered current and its value proved by British officers and sportsmen."

Greener, in his "Modern Breechloaders," published about 1868, mentioned 84 pounds sterling as the price of a Purdey best double rifle. Eighty-four pounds was then the equivalent of about $410.00 of American money; about five times as much as the average American double rifle brought.

At the time when Frank Forester was writing, James Purdey the first was an old man. The Purdey rifle which is illustrated was made by James Purdey the second, who was born in 1828. He fully sustained and even increased the high reputation which his father created.

In those days, to be a great gunmaker was to be an artist also. Art in gunmaking demanded of the gunmaker a highly cultivated sense of proportion, which was based upon accurate judgment of what was best in form, and upon a technical knowledge of the anatomy to carry it out. Another requisite was an educated taste in colors, which enabled him to select, for the finish of his wood and metal, refined and pleasing tones which blended into an harmonious whole; and if he chose to emphasize with light, or dark, or bright color among neighboring less pronounced tones or colors, to place that emphasis correctly. The exact joining of metal

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parts, or of wood and metal, he could safely leave to his workmen, together with the surfacing, to the highest degree, of all portions whether visible or hidden. A knowledge of interior and exterior ballistics, up to date for his time, or, preferably, in advance of his time, was of vital importance. All these requisites of a master craftsman could, however, be common to many gunmakers.

Many a man of long ago has questioned whether the most expensive gun by the most fashionable maker was worth the extra price; and one has said, "Put two new guns, with their labels covered, one a 'best gun' by the most celebrated London maker, and the other a best grade of a provincial maker of repute, into the hands of any expert, and I defy him to tell which of the two is the expensive one."

Certainly both guns may have been the product of genius. Genius means superlative ability working with superlative care. Of two guns judged as beautiful arms — that is, judged visually, — an expert might not be able to pick the more expensive one.

But in work done with superlative care there is a quality dependent upon money alone, which, not being apparent to the eye, could not be detected by any expert. That is, and was, wearing quality of the utmost extent that can be produced. The superlative care of the less fashionable man who obtained less for his gun was spent upon the best materials that he could afford. But the work of the great master craftsman was done upon the best

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materials that the world afforded; and from finished parts made from such stock he used, in his highest-price guns, only those which successfully stood exhaustive tests.

In selecting walnut for a stock, it was not sufficient that it should be the handsomest, finest grained, and lightest; nor that it should be well seasoned; a completely reliable, very old piece was taken; one that had been cut so long, and air-dried so thoroughly, that not in all time would it shrink another particle. It was expensive. In adjusting a pair of rifled barrels, they were fastened together, targeted, taken apart, readjusted, targeted, over and over again, indefinitely and with boundless patience, regardless of time and expense, until they shot as they ought. In a best gun by a most celebrated London maker even so trifling a part as a screw was made of the finest steel, then tested far in excess of any strain likely to come to it, for torsion, tension, softness, hardness, brittleness; it was rejected even if a turnscrew could burr its slot. In making the parts of a lock, perhaps ninety-nine would be finished to excellence and then rejected as not the acme of perfection; the hundredth perfect piece was expensive when balanced against the cost of a less perfect piece, and so it was with all parts, and with the whole gun.

Such an arm embodied the highest attainable qualities of every kind; in addition to appearance its unfailing service due to its extraordinary wearing qualities made it really worth the extra money.

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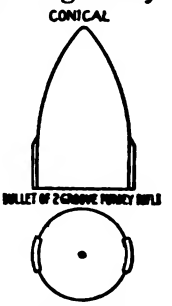
Plate 11

Purdey Double Barrel Muzzle Loading Rifle

No. 1, Marks, "J. Purdey, 314½ Oxford St., London." This rifle was made in 1868 for Lord Macduff, who became the Duke of Fife, in anticipation of a shooting trip in our far West. The outing failed to materialize, which accounts for the unused condition of the rifle at present. The rifle is typical of others which gave admirable service in this country. The total length is 3 feet 10¼ inches; the barrel length is 30 inches. Weight, unloaded, 9 pounds and 14 ounces. When loaded it balances beneath the rear sight. This was called a 40 bore rifle, because it took 40 patched round bullets to the pound; its calibre is .50, not counting the grooves, of which there are two broad ones, each .02 of an inch deep, making the total calibre .54. The rifling is of the gain twist style, beginning at the breech with one turn in 6 feet, which increases regularly until at the muzzle the turn is one in 3 feet. The rifle probably was built for big game shooting in the far West and used a powerful charge having, for the period, high velocity, low trajectory, and great striking power. Under normal conditions the powder charge was 3½ drams of Curtis & Harvey coarse grain rifle powder and a conical, mechanically fitted bullet of the style shown by the cut; the bullet mold is provided with means of casting on the bullet the



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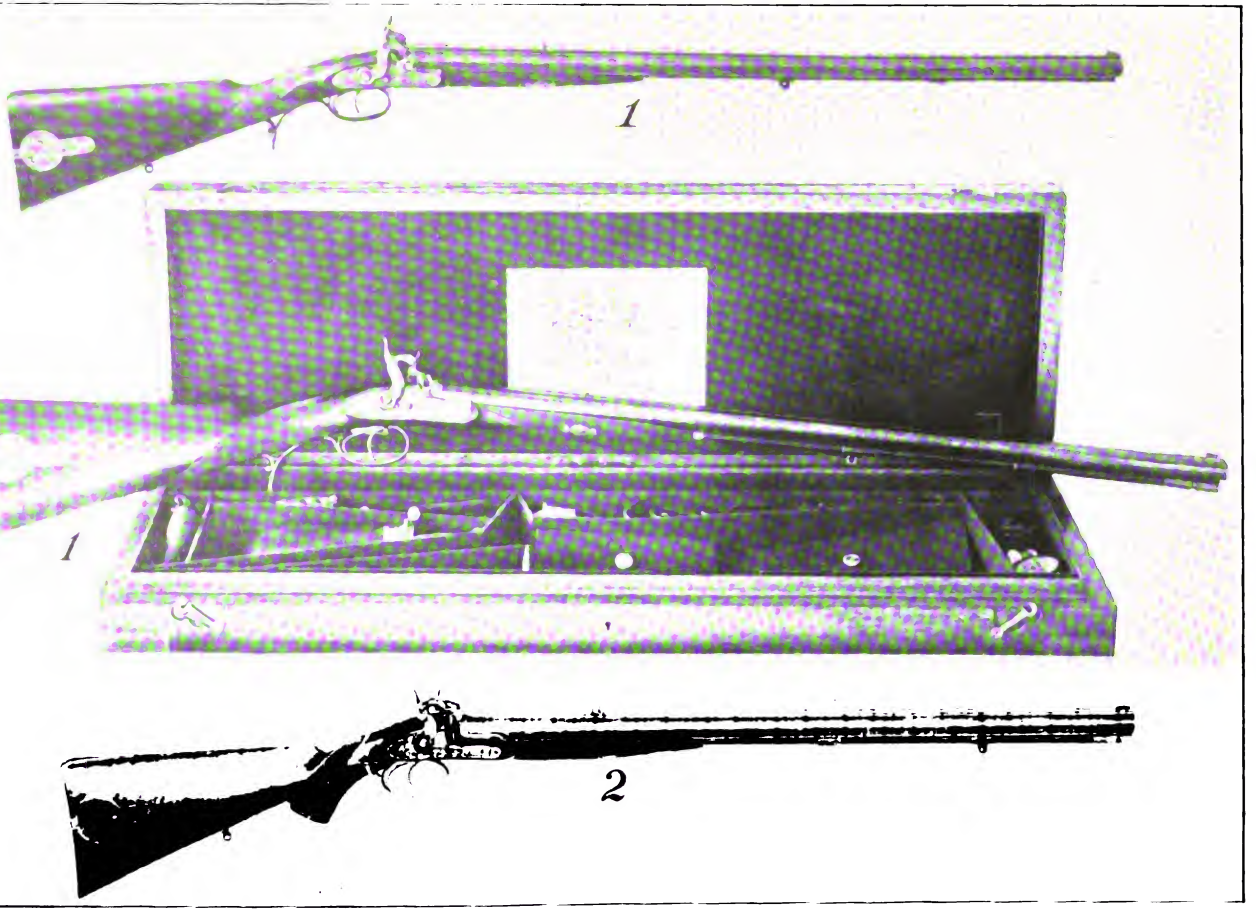

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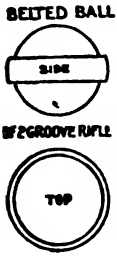
lands that fit in the grooves of the barrel. In case of insufficient range or penetration with this charge, 4¼ drams of powder could be used with a longer and heavier bullet, cast without lands, diameter .488, and used with a circular, greased linen patch. For short range or for small game the rifle would handle with good accuracy either a ball with a belt cast on it to fit the grooves, and used bare, or an ordinary round ball, calibre .525, of half ounce weight, the same as the old American military rifles used. The maker recommended the use of a quarter-inch-thick felt wad between the powder and the projectile.



The barrels are of Damascus twist, rather thick, and, as was the custom, of nearly even diameter on the exterior from breech to muzzle. The rib between them is raised, rather broad, flat on top, and matted at front and rear to minimize any glimmer that might interfere with sighting. The front sight is of the caterpillar type, headed, or tipped, at the rear with platinum. The rear sight has one fixed notch for point blank, — 70 yards — and two folding leaves for 200 and 350 yards each. In each notch the eye is guided by an inserted platinum line. The cones are funnel-shaped, with the large opening at the top and the orifice at the bottom about the diameter of a pin; this shape concentrated the fire of the cap and caused a quicker explosion of the powder charge than when the orifice at the bottom of the cones was big enough to permit the entrance

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of some of the powder, which then acted as a fuse; the cones are lined with platinum to prevent erosion. The ramrod is held in place by a lug on the under rib which snaps into the groove around the head of the ramrod. At the small end of the rod there is an inset line which comes flush with the muzzle when the normal charge is in place. The locks are of such admirable workmanship that nothing better can be imagined. In front of each hammer is a sliding safety bar to lock the hammers at half cock. The trigger pull is light and instantaneous. The stock is of fancy walnut, so perfectly seasoned that it has not shrunk a particle in fifty years. The cheek piece is outlined with delicate mouldings which enhance its graceful form. The butt plate is of steel, and is engraved with a statement of the powder charge and kind to use.

The lines, colors, and workmanship of this rifle are incomparably perfect. The oak case, lined with red cloth, and with both open and covered compartments, holds a store of trinkets to enable the rifle to be used and kept in order under all sorts of circumstances.

Alexander Henry Double Barrel Muzzle Loading Rifle[3]

No. 2, In North Britain, Alexander Henry of Edinburgh was the most celebrated British rifle maker. He invented a system of grooving which made him famous; the Martini-Henry rifle, a mili-

[3] Renwick Collection: courtesy of Captain Wm. G. Renwick.

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tary arm much in use up to twenty-five years ago, was bored and grooved upon his system. In double barrel sporting rifles he advocated larger bore and more weight than most of his contemporaries. The specimen shown weighs $11\frac{3}{4}$ pounds and shoots a seventeen bore (sixty-six calibre) heavy, conical, explosive bullet.

The close of the cap lock muzzle-loading period is devoted to a special purpose rifle which was not classed with others because of its exalted rank. This was the heavy target rifle, the instrument of precision which permitted the scientists of the day to make those great strides in the mathematics of ballistics on which were founded the computations at present so absolutely necessary to the designer of arms and ammunition, the ballistician, and the artillery officer.

In its day its purpose and possibilities were so little understood by the masses that even a well-educated sportsman wrote in 1856 as follows: — "During the period of European improvements in this arm" (the sporting rifle) "science made no advance in America, save in what may be called the frivolities and fripperies of the art. Target shooting from rests, with telescope sights, patent loading-muzzles, and other niceties, very neat, and doubtless telling on the practice ground, but wholly useless and ineffective in the field, came into vogue with all the rifle-clubs and companies of nearly all the original thirteen states, owing partly to the disappearance

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of those species of game against which it was employed."

The heavy target rifle did not make marksmen but served scientists. It was a species of cannon. Its weight was borne by a strong bench and not at all by the firer, thereby eliminating all human errors in holding. By its use a great deal of value was learned which could not be learned in any other manner, such as the comparative worth of different systems of boring and grooving, the effect of wind, of quantities and qualities of powder, of weight and shape of bullet, of the bullet's path, etc., etc. The shooting of the heavy target rifle was marvelously regular and dependable. By placing the target on a Robins ballistical pendulum valuable data were gained as to velocity, striking energy, trajectory, drift, etc., and from these data useful formulæ were compiled.

The " frivolities and fripperies " complained of by the writer who viewed rifles only as adjuncts to game-getting were, as was everything else that assured accuracy and regularity of shooting, absolutely necessary to it. They consisted of a false muzzle, a bullet starter, telescope sight and micrometer adjusting screws. Of these only the false or " patent " muzzle was a recent development. Like almost every other adjunct to firearms, its origin was claimed by many; the patent for it however was granted in 1840 to Alvan Clark of Cambridge, Mass., celebrated maker of telescope lenses. The object of the false muzzle was to serve as a funnel to assist

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the entrance of the base of the bullet undamaged into the muzzle when loading; the object of the bullet starter was to start the bullet down the barrel bearing evenly on all the lands, untipped, with its long axis coinciding with the axis of the bore. Conical bullets of those days rarely had a bearing on the bore longer than quarter of an inch, and the accuracy of their flight was dependent upon their concentricity with the bore, their perfectly true base, and their correct delivery from the muzzle.

The false muzzle was originally a part of the barrel; barrels in wheel, cap, and flint lock days usually were slightly funnel-shaped at the muzzle; the difference between such a muzzle and a false muzzle was that the false muzzle was to be removed before firing, in order that the bullet might make its exit from a true muzzle exactly of the bullet's size and perimeter, sharp-edged, exactly square with the bore. This form of true muzzle had been found to give the best results; and to load into and maintain this form of muzzle without the protecting and auxiliary false muzzle was impossible.

The false muzzle was made on and with the barrel. The barrel was drilled, straightened, rough bored, and funneled at the muzzle; as much of the exterior of the muzzle end as was to become a false muzzle was then turned cylindrical, exactly coaxial with the bore. From the muzzle end, and close to the perimeter, four small holes were drilled parallel to the bore. The piece that was to be the false muzzle then was sawed off, both sides of the cut

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trued, the piece replaced, held in place by steel pegs driven into the four holes, and the barrel and false muzzle fine-bored and rifled. The false muzzle was then supplied with a shield for blocking the sighting of the rifle to assure the removal of the false muzzle before firing, in order that it might not be shot away.

The bullet starter consisted of a piston, fitting over the false muzzle, and within the piston a close-fitting sliding rod, exactly concentric with the bore, one end of the rod being hollowed to the exact shape of the tip of the bullet, and the other end enlarged and flattened so as to be so comfortable to the hand when pressure was applied to start the bullet.

The method of loading was as follows: a weighed charge of powder was poured into the clean barrel; if a patched bullet was to be used a greased circular linen patch, cut with a die, was laid in the recess made for it on the false muzzle; this recess insured the concentricity of the patch. The bullet base was then pressed against the centre of the patch, causing patch and bullet to enter the false muzzle about as deep as the tip of the bullet; the starter was then placed on the false muzzle and the piston rod pressed gently until its hollowed end encountered and centred the tip of the bullet; then the bullet was pressed down into the barrel. The starter was then removed and a ramrod, which was the exact size of the bore, used to seat the bullet on the powder.

Both patched bullets and bare bullets were used, the latter being cannelured and greased. Either kind was made in the rough by casting in a mold.

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If to be patched, usually they were made of pure lead; if to be shot bare, the lead usually was hardened by melting with it a little silver, or tin, or antimony, or adding a little mercury. Composite bullets were much liked, the front part being composed of 89 parts lead, 10 parts mercury and 1 part tin; and the rear part, which took the rifling, made of pure or nearly pure lead. The object of the mercury in the forward portion of the bullet was not merely to harden it, which was incidental, but by its greater weight to shift the centre of gravity as far forward as was compatible with that shape of bullet.

The bullets as they came from the mold were weighed and those rejected which were 1 grain under or over weight. The good ones were then swaged. A swage consisted of a former and a rod; the former was a piece of steel with a cavity the far end of which was the exact size and shape of the desired bullet. If the bullet was to be shot with a patch it was put in the former, pushed into place with the rod, and the rod struck a predetermined number of blows with a miniature pile-driver. If the bullet was of the cannelured type its cannelures first were filled with grease to prevent them from being obliterated by the swaging. Bullets obtained from the swage were as nearly free from flaws and internal hollows and as nearly true in form as they could possibly be. Powder and bullets, then, could be reckoned as approximately perfect elements in the performance of the rifle.

The rifle itself, its bore and grooves, — and the

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instruments which cut them,— received the utmost mechanical ingenuity and skill. All sorts of bores and grooves were tried; cylinder bore, choke bore, and freed bore; plain twist, gain twist, and reduced twist; grooves wide or narrow, deep or shallow; ratchet grooves; few and many grooves; no grooves at all, but their purpose secured by a spiraling bore that was elliptical, square, or many-sided. The polysided bore was found to give best results only when the projectile was first formed to fit it; in other words the bullet must from the first be a mechanical fit; so the polysided bore was abandoned in America, in spite of the fact that the 6-sided Whitworth bore was having a popular run in England.

The result of trial of all conceivable forms of bore and systems of rifling caused the elimination of the freed bore and showed that the gain twist was undesirable for bullets having a long bearing surface but was excellent for the type called picket and for the spherical bullet. Otherwise, if the rifle was mechanically perfect and the ammunition was correctly adapted to it, one system of rifling gave as good results as another. The modern ballistician who is used only to the rule that modern fixed ammunition is designed first, and then the rifle built to handle it, may be shocked to learn that in the days of loose ammunition the rifle came first and the charge best adapted to it was determined by experiment. Putting the cart before the horse nevertheless produced results that modern rifles rarely approach. The cuts of targets made with

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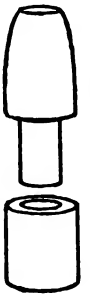
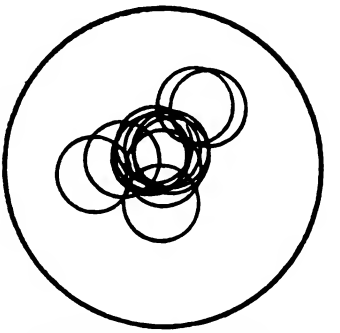
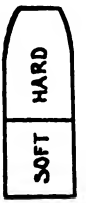
heavy target rifles do not represent two of the best but merely two out of a multitude as good.

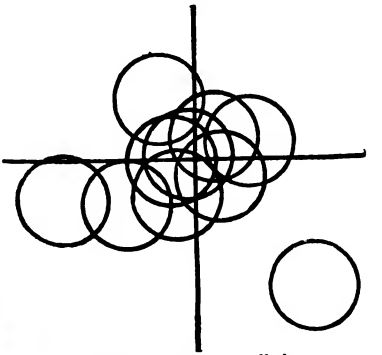
These two targets, made with cap lock, muzzle loading, gain twist rifles, were published in "Shooting and Fishing" of May 11, 1893. They were made, date not stated, by J. H. Gardner, of Scranton, Penn., with target rifles of his own make, the barrels of which weighed about 15 pounds apiece. In both cases the rifles were shot from the shoulder with muzzle rest. The kind of sights was not mentioned. The bullets were of the two-piece variety shown, in which the rear, soft lead portion was swaged onto the hard front part.



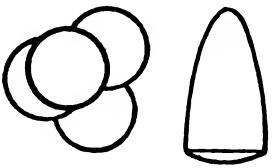


10 shots at 110 yds. Full size





10 shots at 220 yds. Full size



9 shots at 110 yds. Full size

These two targets were made with cap lock muzzle loading rifles. The diagrams and data were published in "Forest and Stream" of Nov. 20, 1890. The left-hand target

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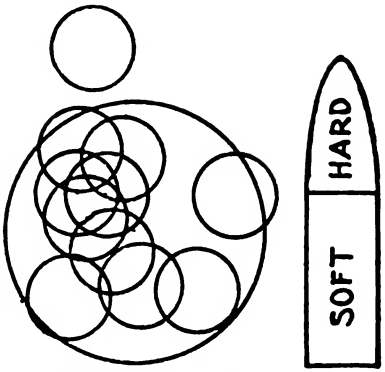
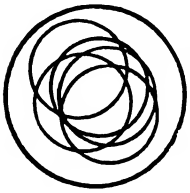
was made in 1859 with a heavy match rifle made by Morgan James, gain twist ending in about 30 inches; charge, 210 grain picket having a greased circular linen patch, and 90 grains of Hazard F. G. powder. These 9 shots, 6 of which went into the centre hole, were shot for a group; the 10th shot was omitted through fear of spoiling the group. Modern rifles, attention! salute!



11 shots at 200 yds. Full size

The right-hand target was made in 1890 with an ancient J. V. Perry rifle, even twist of about 1 in 14 inches, 600 grain composite bullet, 100 grains of Orange Ducking powder.

This target of 5 shots at 110 yards was made in 1876 with an H. Warner cap lock muzzle loading rifle by Mr. Warner himself at a public shooting-match, and was verified in the presence of at least 50 men by such celebrities as Wm. Billinghurst, H. M. Martin, Cyrus Bradley, and others. It was shot from a rest with plain globe and pin head sights, target centre fixed before shooting. These data and no more were published in "Shooting and Fishing" of Dec. 11, 1890.



By the time the Civil War opened the heavy target

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rifle had enabled the ballistician to compile a lot of approximately correct formulæ for computing:

The muzzle velocity of a bullet from its weight and diameter and the powder charge; the height of the trajectory; the striking energy at any distance; the angle of fall at any distance; the remaining velocity at any distance; and of course any educated man could figure the time of flight and the retardation, acceleration and drift due to wind. Up to the Civil War target rifles had been scientists' instruments and a few other men's playthings. But the frequent deadlock of opposing armies caused each side to resort to snipping[4] on a large scale. On both sides any soldier with regimental, battalion or company reputation as an expert shot was, on such occasions, supplied with an extra good rifle, detached from company service and ordered to build himself a fort on a hill or a platform in a tree and stay there and snip enemy officers. The rifles supplied were obtained by the government in two ways: they were made under contract, plain but serviceable arms, and such a one is shown in Part III among the military rifles; the other way was by sending agents throughout the Eastern and Middle Atlantic States to make a house-to-house canvass for extra heavy good rifles. Two such are shown on the accompanying plate.

[4] The modern pronunciation "snipe-er" and "snipe-ing" is incorrect. There is no verb "snipe" from which to derive these words. The verb snip, meaning to cut quickly, to clip, originally furnished the words snipper and snipping, and snipping expresses exactly the performance of taking deliberate aim from ambush and clipping the life of an unsuspecting victim. It is all right in the interest of brevity to omit the second p in spelling, but it is all wrong to pronounce these words inanely.

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Plate 12

No. 1, Light weight target rifle.[5] Selected as generally representative and also for the rare feature that it was made to order abroad instead of at home. J. Blanch & Son, maker, London. This sort of arm in England was called "match rifle." In the United States this rifle classed as a light-weight because the weight was under 12 pounds. It was not provided with a false muzzle, but did have a bullet starter; it was rarely fired from a rest, but from the shoulder with the left elbow resting on the hip bone. Excellent shooting could be had from it, qualified, always, by human errors in holding and in trigger, technic; in workmanship, judged from the exterior, this arm surpasses the average.

No. 2, Medium weight target rifle. Such arms came between the 12 and 18-pound boundaries. While very comfortable to use off-hand, and occasionally so used for squirrel and crow-shooting, the arm was, by its weight and muzzle heaviness and its impedimenta, more of a rest-shooter's instrument. It is marked on the barrel "G. V. Ramsdell, Maker, Bangor." And on an ornamental silver name plate set into the cheek piece is engraved the name of the man for whom it was made, "W. A. Frye." The calibre is .40; the pitch left hand, one turn in 40 inches. The bullet cast by its mold is of the 2d picket type. The silvered furniture is neatly en-

[5] DeMeritt Collection: courtesy of Major John DeMeritt.

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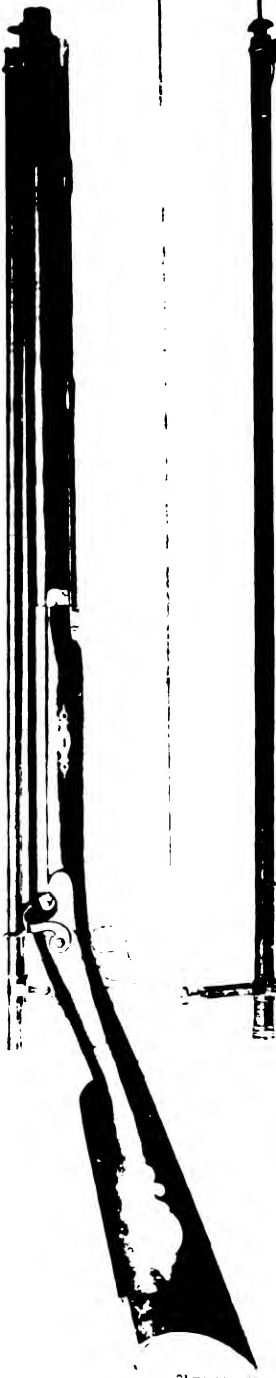

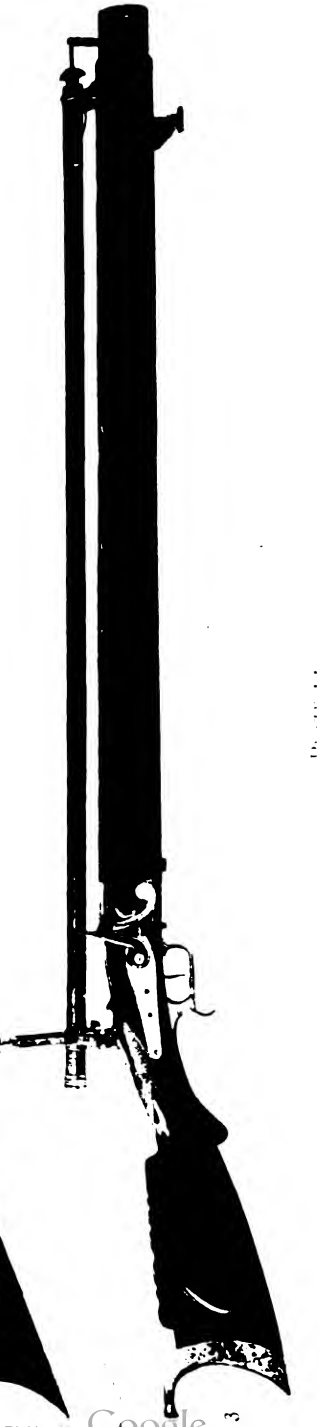

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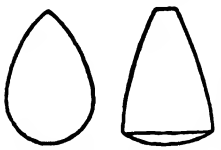
graved. The butt is of rich color and fancy grain. The telescope is of 12 power or thereabouts. For the period, about 1850, it is a good one, strong, clear and sharp; but compared with a modern one it offers a field both dark and small. For ranges not much over 40 rods this rifle, fired with muzzle rest, may have been very accurate; it will be extremely interesting, some day, to give this rifle, and also No. 3, a try-out.



1st picket type 2d picket type

No. 3, Heavy target rifle. A scientist's instrument rather than a mere rifle. It was not held in the hands when fired, but lay on a bench or stout table, supported, at the forward end, by the steel bracket, or foot, shown; and at the rear by the set-screw beneath the breech resting on an inclined plane of metal; or by an apparatus which was capable of vertical and horizontal adjustment secured beneath the breech by means of the set-screw and the adjacent steel dowel. The shooter sat behind the rifle and a little to one side; and could put either shoulder to the butt, because the stock has a cheek piece on each side. The recoil, however, was not severe. Its weight is thirty-seven pounds; its calibre about .68; its rifling has six ratchet grooves; the pitch is of the gain-twist variety, beginning at the breech with one turn in 5 feet and ending with one turn in 3 feet. The owner had at least a dozen different bullet molds casting a great variety of elongated bullets, cannelured and smooth, long and short for, and not

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for, use with patch; and also the hollow base variety such as the army used in the rifle musket. As to which kind Captain John Metcalf used, the reader may make a guess. The telescope, of about 25 power, is so light and has so large a field that it rivals a best modern one. The scale on its mountings, which are adjustable both vertically and horizontally, reads in minutes of angle. The barrel is marked "Abe Williams, Maker." On an ornamental insert in the top of the butt is engraved "Little George Lainhart." On the left side of the stock are two gold hearts, close together. The stock is of rosewood, the use of which for gun stocks has always been unusual. The fittings and finish of this rifle are of an expensive character.

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In the two generations from John Metcalf, the pioneer, to John Metcalf the 3d, his grandson, educational advantages in the old settled region along the Atlantic seaboard of the United States had heightened wonderfully the natural native intelligence. Manners also had changed from rough to smooth; barbarous customs had become obsolete, and both work and play were of higher grade; still, however, the old-time love of arms persisted. Now, however, it was broadened and enriched by the introduction of a considerable amount of scientific knowledge applied with cool reason.

John Metcalf 3d, graduate of West Point, officer and gentleman, was a better specimen of man than his grandfather. While such as he had been in process of development an advance at least equal had occurred in rifle capabilities. Thus John 3d was able to use mind and knowledge in a way impossible to his ancestor; and with a special weapon of his later period he was able to perform a feat hitherto unparalleled and even on a par with the best that we, his descendants, find to be about our limit. Considering that Captain Metcalf, in shooting accurately to a distance beyond the vertical adjustment of his rear micrometer was obliged to raise his muzzle mechanically and by cold calculation until his telescope pointed to the sky and his target was unseen, our vaunted "indirect fire" is no great recent accomplishment. Also so far as reaching a distant objective is concerned, we of the present time have not progressed so much from John 3d as he from the pioneer. But our children, the 6th generation, will go further.

At Long Range

As the battle had come to a draw, and both sides were exhausted, they drew apart several hours before sundown, and went into camp to rest and prepare for further exertions. One army occupied the gentle eastern slope of a chain of low hills near the sea. Scouts, upon their tops, looked to the west across a plain one to two miles wide, to the other army, which rested upon the eastern slope of a parallel

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line of hills. The general in command of the army by the sea called his brigadiers and colonels to a conference.

Shortly afterwards an orderly from headquarters summoned Captain Metcalf. "Captain," said the general, "it seems probable that there may be several days of inactivity. Our opponents are officered by only three experienced and really capable leaders; their other officers are mostly political appointees, quite incapable, and they have not the confidence of the rank and file. It is, of course, self-evident that the removal of those three officers — or, perhaps, even of the commander only — would result in a reluctance to engage us again in battle. It is extremely probable that the opposing army would even fall back upon the support of their main army, leaving this section of the country free of our enemy's operations. That would entirely change the strategy of this whole campaign, and change it greatly to our advantage."

The general paused for a few moments, as if considering how to express himself; then he continued, "I am about to make use of your skill as a rifleman and an artillerist upon the persons of our enemy's leaders. You will find in our baggage train a number of heavy rifles mounted with telescopes for sighting, and capable of shooting accurately at a great distance. Take your choice of them. Take men and stores and make a blind where you can see the whole of the enemy's camp. Your orders are comprised in only three words, 'Move the enemy'!"

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Captain John Metcalf 3d and half a dozen men, all of them bearing burdens of tools and materials, scrambled up the eastern side of the hill known as Blood Top, cautiously crawled over the ridge, and down into a slight depression like a two-hundred foot shallow saucer which formed the broad top. Many large stones were scattered about it, and numerous clumps of bushes grew in the moss and damp soil which floored the middle of the hollow. Standing, a man's head and upper body could be seen by the enemy through their field-glasses; motion would attract immediate attention; so the captain and his men sat down while he looked about and planned his hiding-place.

The enemy's encampment, far off to the west, was hard to see. The late afternoon sun was in the captain's eyes, the hillsides forming the background of the encampment were in shade, and tents, horses and men blended into it. The wind was blowing towards the enemy. It would blow that way every sunny afternoon, from the cool sea behind to the heated plain between him and the enemy, and would reveal the smoke from the rifle. Afternoon, then, was work time, and tomorrow morning would be rifle time.

So, at first crouching low, the captain and his men at once got to work. Bushes were replanted with roots entire to form a screen. A hole like a small cellar was dug, and floored with boards. Then fifty men appeared, bearing planks, scantlings, carpentering tools, surveying instruments, and the

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big rifle. A stout table was built upon the board flooring, the rifle was laid upon it pointing to the enemy, a lever operated muzzle raising device installed, and a seat was built behind. Then a light framework of scantlings was made, canvas painted green was nailed over it, and upon this covering bushes were scattered and fastened before it was erected. The captain's blind, then, was a funnel which had a broad mouth toward the west and a narrow one behind. It was a shelter from the sun and from possible rain; and it was also a sort of horizontal chimney-flue to whisk powder smoke away from the enemy's sight when the morning breeze blew toward the sea.

The captain took his place at the firing table, and with a soft pencil began sketching on its top a map showing his position, the valley, and such of the tents way off in the distance as he judged to belong to the principal officers. Also he indicated the various parks of artillery. On the map he ruled faint lines between the firing point and the targets on which, later, to note distances. Meanwhile three men under a lieutenant were establishing a base line upon which to compute ranges. For the sake of extreme accuracy, and also to save time, they used a theodolite; but any boy with a slight knowledge of geometry and algebra could have obtained fair results with a tape, a compass, and strings. First they drove a spike in the table directly beneath the muzzle of the rifle; to this they fastened a stout cord; then the lieutenant,

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with the theodolite, ran a line at right angles to the rifle barrel, and at the far end of the line, on the southern rim of the hollow, a crowbar was driven deeply and firmly. The cord was drawn tight and fastened between the spike and the bar. On it one hundred feet were laid off accurately and marked. The lieutenant set his instrument at the one hundred foot mark.

The captain called, " Let me have the angle of the major-general's tent; take the centre of the door."

" Eighty-eight degrees, 57 minutes, $8\frac{1}{4}$ seconds, sir," the lieutenant answered. The captain figured for a few minutes. The distance from the muzzle of the rifle to the door of the distant tent he found to be one mile, one hundred and eighty-seven feet. This range he marked upon the map.

Approaching darkness prevented further work, and the captain, after writing several orders and requisitions to be delivered at once, withdrew with his men to his own camp. He sat up late that night making mathematical computations, and tabulating and captioning the results for quick reference. While a few hours in his lair and a single shot might chance to be sufficient, nevertheless he prepared data for many contingencies, and simplified the data as far as possible for instant use at critical moments.

By sunrise the next morning the captain and his lieutenant were on the hilltop. The first thing done was to complete the map of range-marks. Then the captain spread out on the table his sheets of

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computations of the heights to which the bullet from his rifle would rise in traveling to each of the targets; the angle of its fall at each target; the time the bullet would be in the air; the effect of side winds; the amount of retardation due to a head-on breeze of six miles, and eight miles, blowing against it. Next he examined with great care the fixtures on the breech and muzzle of the rifle which permitted horizontal and vertical deviations of the telescope sight. As well as he could judge, when the indicator at the muzzle was set at the O mark the axes of the telescope and of the rifle were in a vertical plane. Then he made the necessary adjustments for one mile, one hundred and eighty-seven feet.

So far, all steps toward hitting a given spot at a given distance were based upon theory. Theory and practice in long range rifle firing often fail to agree; in fact, at that time, when powder was a varying compound, theoretical ballistics served merely as a broad basis for practical work. So the captain had provided means for testing his calculations. Upon the sea-beach the engineer corps of his army had just completed setting up a man-size white silhouette one mile one hundred and eighty-seven feet from the firing point on the hilltop. The captain merely reversed his rifle. His man went down the hillside a little way to a point agreed upon and waved a signal. The men near the target ran away. The captain fired. "Allowing two feet higher on the target for the difference between shooting with a six mile breeze and against it, if I have

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hit the thing at all the mark should be in the head; I sighted at the belt line to get as much bullseye as possible."

The captain kept his eye to the telescope. The engineer corps signaled a miss. Then they extended a canvas screen behind and above the target, like a wall 15 feet high and thirty feet long. The captain fired again. This time a man at the target placed the centre of a large disc over the bullet hole in the screen, enabling the captain to locate his shot. It was in line, horizontally, with the knees, but fully five feet to one side. "Drift?" queried the lieutenant over the captain's shoulder. "Probably," answered the captain; "also the powder is weaker than I figured it would be." He made a careful adjustment at the front of the telescope, looked once more to the clouds, the trees, and the grass for signs of flaws in the wind, and didn't find any; made a slight difference in elevation to cause the bullet to strike chest high when aimed there; and fired once more. "Third time never fails" encouraged the lieutenant. The man at the target placed his marker over the region of the chest. "A bullseye," the captain remarked, in his even matter-of-fact manner. Then the rifle was once more pointed towards the enemy.

The captain made some changes in a tabulation of front and rear positions and then sat back to await developments. The morning breeze, moving eastward, drew pleasantly through the funnel-shaped tunnel. Outside in the summer sunshine heat-

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waves eddied up from the hilltop. An occasional fly buzzed lazily. Yellow cabbage butterflies wavered about, visiting the stalks of mullein flowers. There were odors of herbs such as pennyroyal, thoroughwort, boneset and other homely simples, familiar to the captain in his boyhood; some came from plants in view and others were in the warm air coming from below. Out on the plain there was a brook and a marsh where undisturbed wild life went on as usual. A hawk wheeling on quiet wings spied a summer duck gleaning a late breakfast, swooped and caught it. The little tragedy conveyed no significance to the musing captain. The lieutenant, lacking something else to do, took up the wiping rod and once more scrubbed and oiled the bore of the big rifle. The captain, casually watching him, began to take notice of the unusual elegance and finish of the weapon with which he was about to attempt to snip a human life. The stock was of rosewood, with a cheek piece on each side so that a sitting marksman might use it from either shoulder. The polished silver furniture was nicely engraved.. On an insert he read "Little George Lainhart," and near the name were inlaid two golden hearts. "Odd, isn't it," he remarked to the lieutenant, "the same name, the gun here and the general to be snipped out there. 'Little George'; the great to be made little. Now, if I were one of my superstitious ancestors I should consider these signs an omen. I have been shooting all my life, so I know that ordinarily that man would stand

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small show of getting hurt. But this time — queer. What about the golden hearts; his and mine? Rubbish. Mine's lead. Don't know. But I know this is a rotten job."

He took up his field glasses, which gave a much more extended view than the telescope, and focussed on the enemy. The camp was quiet but busy. The tents, forming company streets at right angles to and on both sides of a highway, had been made ready for inspection and were now, except those of the high officers, open to the air. In the morning sun men were sitting upon the grass mending their clothes. Officers were moving about, in a leisurely way, inspecting arms, horses, wagons and all other paraphernalia. A blacksmith with a field forge in full blast was shoeing mules. Near the commanding officer's tent, distinguished by a pennant marker, three officers sitting on drums, with maps pegged to the ground about them, were in animated debate. An orderly rode up, saluted, and delivered a packet. "Aha," said the captain, "their rank deserves looking into."

He set down his glass and put his eye to the telescope. Through it the distant officers seemed not more than a couple of hundred feet away. Details of color, uniform, insignia of rank, could be seen perfectly well. "Watch the wind!" he said quickly. "That left hand officer is second in command and I am going to try for him." He altered his wind micrometer about a thousandth of an inch and shifted the rifle to get the telescope to bear again.

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The lieutenant remarked, "Wind is getting a little flawey as the plain warms up; there seem to be three layers, and the middle one, just below our level has changed to the north; — light; — about six miles I think." The captain made another adjustment of wind gage and rifle, stepped on the lever beneath the bench which caused the muzzle of the rifle to rise toward the sky, put his left hand across his breast and behind the butt of the rifle to catch it when it recoiled, and very gently touched the set trigger.

The tunnel heaved with the heavy report and a thick cloud of smoke was blown back in their faces by the brisk breeze and whisked down the hill towards the sea. The captain lowered the rifle and looked again through the telescope. The lieutenant stood by, watch in hand. "I believe you said it would take the bullet about four and three quarters seconds to get there, didn't you, sir?" His watch ticked five times to the second and twenty-three ticks, nearly twenty-four, seemed ages long. Through the telescope the captain saw General Lainhart come out of his tent near the officers and step briskly towards them. All three officers rose and saluted; the man who had been fired at, perceiving that he had stepped on a map, took a step sideways; General Lainhart, still advancing, smiled at him, and on that instant spun around, fell in a heap, tried to rise, then relaxed to a position flat on his back. The officers sprang to him; men came running; the general was carried into his tent.

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For less than half a minute the quiet of a peaceful summer morning continued on the hilltop and in the heated, wavering air above the plain; then the hill itself seemed to rock under the tremendous volleys of artillery opened upon the enemy's encampment. A few minutes later and their pickets could be seen running in followed by the advance guard of troops of cavalry. Behind the cavalry followed regiments of infantry charging at double time. The camp of the enemy became a haze of confusion. Then out of the blur sprang long lines of fleeing men and galloping baggage vans, gorging the road that led to the beyond. The retreat was a rout.

Captain Metcalf watched the army of his own country take full possession of the camp and begin turning it into a prison pen. Then he took the great rifle in his arms and turned to go. Just coming over the crest and down into the hollow was his own general with half a dozen or so of his staff. The captain, quiet, quizzical, seeming even a bit dejected, took his place among the staff. His general, calm and unemotional as if nothing unusual had been going on, remarked casually, " Captain, I saw you move the enemy." Then, smiling slightly, " You have seen how certainly I counted on you."

Captain Metcalf answered with a salute but made no direct answer; instead he showed his general the name engraved on the plate let into the rifle, and with a slight gesture towards the camp across the valley he asked " Do you know if *he* was ' Little George Lainhart '? " The general considered awhile

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as if musing upon the uncertainties of fate, then answered, "No, I do not really know." Then, more warmly, "But I congratulate you upon your success. You made a wonderful shot. Your skill borders on the marvellous."

The Captain, being a West Pointer, was too honest to accept credit where none was due. "It was a case of the fortune of war for both of us, sir," he answered. "The shot was a fluke. My target moved away and that more important one took its place. But the bullet actually did go where it was aimed, and for that the rifle and I will go halves on the congratulations."

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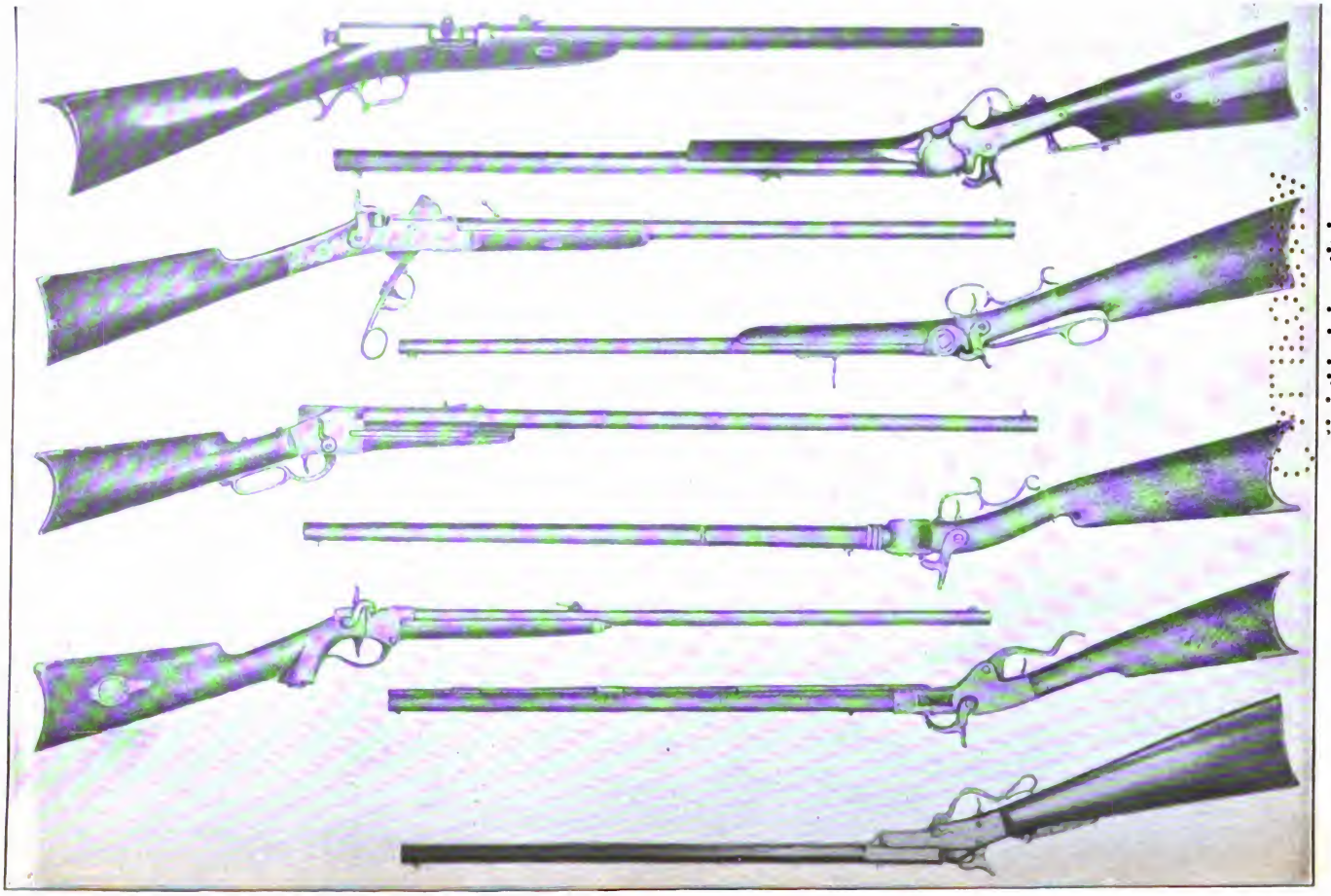

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PLATE 13

Although in cap lock days breech loading single shot rifles were common as military arms they were but little used as sporting arms. The reason was that breech loading was somewhat impractical. A joint at the breech could not be avoided; if tight enough to prevent leakage of fire, powder residue quickly fouled it so that the breech could not be closed; if loose enough to accommodate considerable residue, fire leakage was dangerous to hands and eyes. The army and navy were reluctantly disposed to put up with the inconvenience of breech loaders on account of the advantage of rapidity of fire; the majority of all sportsmen were shy of the single shot breech loader. Of the different specimens shown on Plate 13 the Perry received the most praise, and at the present day it appears to be the best of the lot; but so few were made it never had the thorough test that long use alone can give.

Plate 13

No. 1, Klein rifle. The design of this arm was claimed by P. H. Klein, gunmaker, of New York City. This needle rifle was probably the first American bolt action rifle. Mr. Klein, however, was by no means the first inventor of the action, for it was an almost exact copy of that designed by Jean Nicholas Dreyse, of Sommerda, Germany, who patented it in 1836, and the fame of which later sounded throughout Europe. From the Dreyse gun sprang all the bolt action needle rifles famous up to and through the Franco-Prussian War; and from

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the bolt of the needle rifles the bolt mechanism of modern rifles was developed.

A needle rifle was so-called because of the likeness of the firing pin to a needle. The needle struck through the powder of the paper cartridge to the cap located either on the base of the bullet or on a wad between the powder and bullet. The needle, in the Klein and Dreyse rifles, projected from the face of the bolt even when the bolt was drawn back to open the breech for the insertion of a charge, and was dangerous to fingers and also liable to be broken off. Moreover the heat of the powder gasses corroded it rapidly, so that if a supply of new needles was not at hand the gun became useless while still new.

The needle rifle never was popular in America. It is true that some were used in the Far West after the Franco-Prussian War — discarded European army rifles that were sold for a song to the poorest class of emigrants — but the Klein needle gun was, if not the only, then nearly the only American one. Mr. Klein had 500 of them made in 1849 at the factory of Geo. P. Foster, of Taunton, Mass., and found great difficulty in marketing even those few.

No. 2, Sharps rifle. The Sharps action was patented in 1848 by Christian Sharps. Previous to 1852 rifles on his plan were made in small numbers by several firms. The Mass. Arms Co., of Chicopee Falls, Mass., made a considerable number, and the Maynard Gun Co., of the same place, issued a modification up to 1856. But nearly all that were made

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under the 1848 patents were made by The Sharps Rifle Mfg. Co., founded by the inventor in 1851 and located at Hartford, Conn., from 1851 to 1875, and at Bridgeport, Conn., from 1875 to 1881. The business was discontinued in October of 1881.

By throwing forward the trigger guard a block at the rear of the barrel dropped and uncovered the breech. In closing the action, in case the block in rising encountered the projecting rear end of the paper or linen cartridge, its sharp upper edge sheared it off. Contemporaries wrote that the action leaked fire frightfully.

The general features of the Sharps breech action were maintained throughout the period of its manufacture, but many details were modified. The early specimen shown was provided with a Maynard tape priming magazine; this was discontinued after 1859 and a disc priming magazine substituted which was a combination of the features patented by Mr. Sharps in 1852 and of the device patented in 1859 by his master-armorer, Mr. Richard S. Lawrence. (See Military Rifles; Carbines; also Plate 15, No. 2.) Plain sporting Sharps rifles were nicknamed "Beecher's Bibles." Henry Ward Beecher, a very famous Brooklyn preacher, espoused the cause of the abolition party at the time of the bitter partisan conflicts as to whether Kansas should enter the Union as a free or a slave state. A considerable portion of the large fund raised by Mr. Beecher to aid the abolition party was spent for Sharps rifles with which the anti-slavery Kansans were expected

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to convert the souls of their pro-slavery neighbors They succeeded.

No. 3, Perry rifle. Patented in 1855 by Alonzo D. Perry. Made by the Perry Patent Arms Co., of Newark, N. J., for a short period. Some were double barrel. When a paper or linen cartridge was pushed into the chamber it was torn open by a projecting thorn. The arm used copper caps only and was self-priming from a tubular magazine in the butt. There was provision for automatically removing the exploded cap before fitting on a fresh one. Like most other breech loaders the Perry could be charged from the muzzle.

No. 4, Allen & Wheelock rifle. Ethan Allen's patent of 1855. By continuing to raise the lever shown started in the picture, a hole through the roller across the breech came out of line with the bore and into view.

No. 5, Weaver rifle. Patented by H. B. Weaver of South Windham, Conn. By means of an elbow joint within the frame the breech block could be moved to the right by throwing the trigger guard forward. There was a self-priming device for supplying copper caps from a magazine in the butt. The internal hammer was cocked by the movement of the trigger guard, and also, independently, by the small lever on the right side. Made for a short time previous to 1860.

No. 6, Unknown breech loading capping rifle. Courtesy of the United States Cartridge Company. The chamber is in a cylinder lying horizontally,

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which can be turned by thumb and finger a quarter way around for charging.

No. 7, Sharps light weight rifle, sometimes called the Sharps Pistol Rifle. This kind of arm was a factory product, using the small and light frame of the Sharps single shot breech loading pistol in combination with a shoulder stock and a long barrel. This was not intended for a pocket rifle because of its length and so it does not class as a special purpose rifle; nevertheless its light weight and small bore limited its use to small game and to short range target work.

No. 8, Marston rifle, patent of 1850. A limited number were marketed about 1850 to 1860 by Wm. W. Marston, a sporting goods dealer of New York City.

No. 9, No picture. Schenkl rifle. Patented in 1853 by J. P. Schenkl, gunmaker, Boston. The breech was attached to the rear of the barrel with interrupted screw threads and could be tipped up for loading. Only a few hundreds were made and no specimen was available for illustration.

No. 10, Maynard rifle. This arm sped the departing cap lock and paper cartridge, and introduced the metallic cartridge breech loader. In so doing, at first it sat on the fence and hung a leg on each side. The first Maynards used a copper cap on the usual cone set into the frame behind the barrel. The barrel, which tipped up at the breech for loading, took a brass cartridge with a rimmed head. But the cartridge did not contain a primer;

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instead, there was a tiny hole in the center of the head to admit the flash from the cap. Leaving the copper cap boundary fence, a step to one side or to the other reached, respectively, rim fire and center fire modern ammunition. The breech mechanism established a precedent for simplicity, low cost, strength and reliability.

This specimen embodied the patents of 1851 and 1859 of Doctor Edward Maynard, a dental surgeon of Washington, D. C., who was already famous for his tape primer magazine. Maynard rifles were not the only metallic cartridge arms then on the market, but they were the only ones based on sound principles.

The first Maynard rifles, made in 1859, were military carbines. At the close of the war, the demand for military arms being over, the Massachusetts Arms Co. issued its first lot of Maynard sporting rifles, "Model 1865." They followed closely the lines of the carbines, but differed in calibre, sights, and finish of the wood. Calibres were .35, .40, and .50.

The specimen shown is of .40 calibre and its brass shell took 40 grains of powder and a 270 grain cannelured bullet. In forested regions where the range rarely exceeded 50 yards the Maynard was a very useful gun. The trajectory was of course very high, making guesswork of shooting at long distance.

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Chapter III

THE METALLIC CARTRIDGE PERIOD

The principle of breech loading, about as old as firearms, was, on account of fire leakage and residue clogging, impractical until the invention of the metallic cartridge with expanding case. No inventor, however bright, or workman, however skilful, was ever able to make a thoroughly successful breech-loader until then. Metallic cartridges date back four hundred years or more, but they were merely convenient containers; they were rigid. The thought that the case ought to be thin and springy to seal the bore when expanded by the powder gasses did not occur to inventors, apparently, until about the middle of the 19th Century, and little or no progress was made until then in practical breech loading firearms.

About 1850 many inventors produced metallic cartridges of varying forms and methods of ignition, but almost without exception merely with the objects of safety in handling, rapidity in loading, and possibility of being waterproof. It was only after the thin-wall metallic cartridge had been in use for a considerable time, that the discovery was made that its springy walls had solved the problem of a joint at the breech free of fire leakage and residue clogging. That discovery was claimed by Dr. Edward Maynard, whose capping metallic cartridge

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breech loader has already been described. One step more remained to be taken, and that was to incorporate the cap in the cartridge. For center fire cartridges the evolution of the Berdan primer was that next step. Perhaps it is needless to say that Dr. Maynard adopted it at once and produced gas-tight breech loaders.

Of course after the method proved to be the right one the reasons became apparent. The gas generated by the explosion of the powder acts quicker on the elastic walls of the shell than it does in overcoming the inertia of the bullet, and crowds the expanded shell so tightly to the wall of the chamber that, when the bullet issues from the mouth of the shell, the gas finds no crack through which to escape rearward. The primer acts the same way on the wall of the primer-pocket, and the cartridge case seals the bore at the breech while the gas pressure continues. When the pressure ceases, the cartridge case, because it is springy, contracts slightly, and this contraction permits it to be removed easily. These principles, without variation or addition, are maintained to the present day.

Of the score or so of single shot rifles treated in the beginning of this chapter the target instead of the sporting model has been chosen for illustration, because while presenting the action equally well it offers at the same time far greater variety in shape of rifle, ornamentation, and kind of furniture. Besides the makes described, which were widely known, there were a few others of which so few were issued

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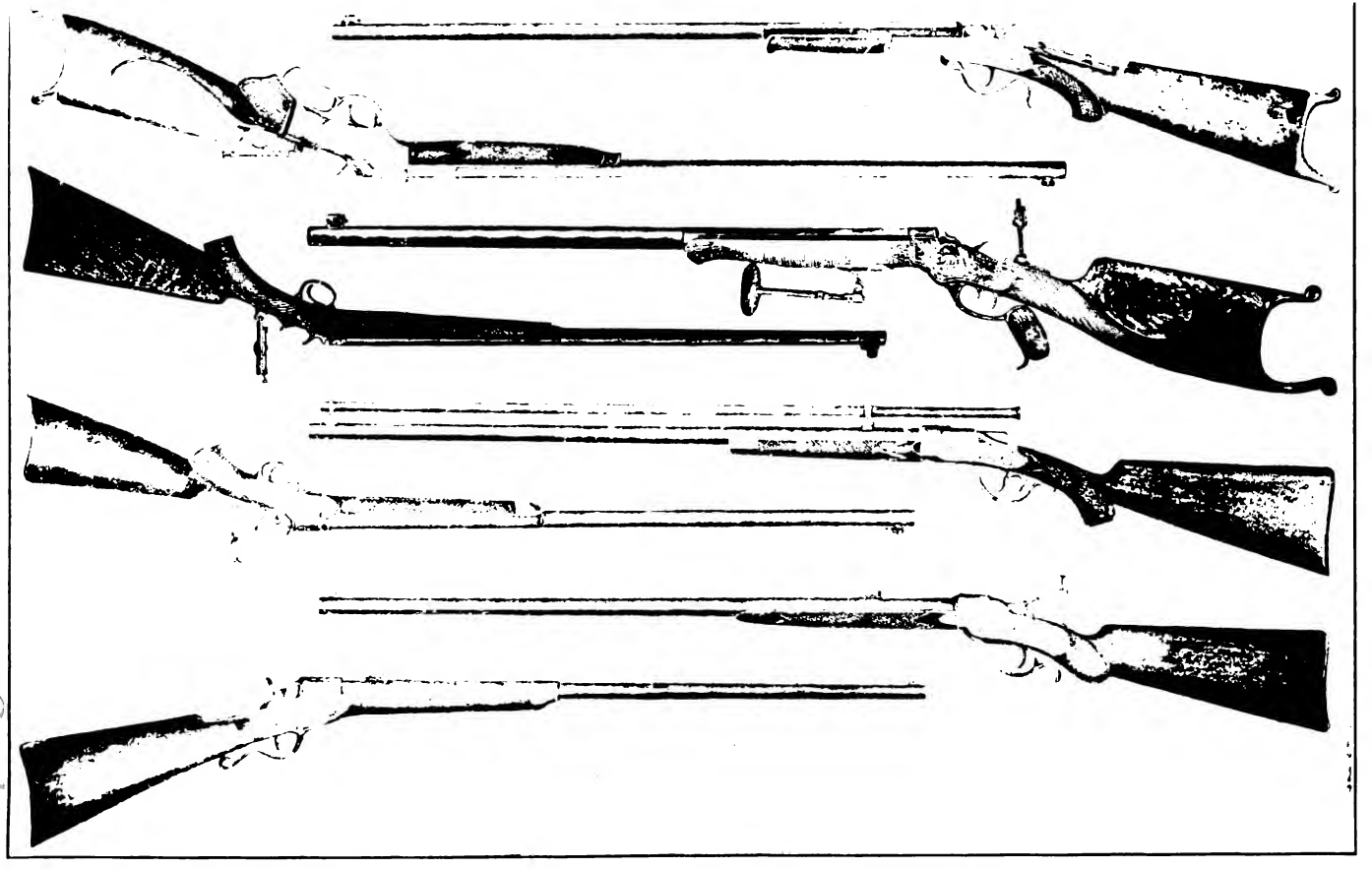

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that they are not now of public interest; and in Part III certain rifles are treated which could not be treated in this chapter without needless repetition.

Single Shot
Metallic Cartridge Sporting Rifles
Plate 14

No. 1, Maynard rifle, type of models 1873 and 1882. Model 1873: — As the popularity of the copper cap waned, and the Berdan primer more and more displaced it, the Model 1865 Maynard, which was a copper cap breech loader, was succeeded by the Model 1873 using Berdan primer center fire special shells and also standard commercial rim fire cartridges. The use of either center or rim primed shells in the same rifle was made possible by Hadley's patent breech device. Barrels were made for all calibres of shells between .22 and .38; and emphasis was laid on the economy and convenience arising from the interchangeability of a series of barrels of varying calibres on a single stock and breech piece. Model 1882: — The Berdan primer was succeeded by the Winchester; and fixed ammunition, on sale everywhere, differed in measurements from the old; slight changes in the Maynard rifle, therefore, became necessary, and the Model 1882 was issued to use up-to-date ammunition. Except for .22 rim fire cartridges the Model 1882 was chambered only for center fire; calibres ran the gamut from 22–10–45 to 50–100–500. In the Mass. Arms Company's

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catalogue of 1885 many excellent targets made with Maynard rifles were published; one made with .22 calibre rim fire ammunition showed 30 consecutive shots, offhand, at 75 feet, in a one-inch circle; at 100 yards, with 32–36–165 ammunition, 10 consecutive shots in or cutting a half inch circle; at 220 yards, with 44–70–520 ammunition, 10 successive shots in or cutting a two and three-eighths inch circle; at 800 yards, 17 consecutive shots all well inside the bulls-eye; and so on, showing that metallic cartridges and rifles of 35 years ago were satisfactory weapons. The manufacture of Maynard rifles was discontinued about 1890.

No. 2, Ballard rifle. Data is given under the heading "Marlin," in Part III. The specimen shown was the most popular one of the various models issued by the factory, and is true to type. Such specimens are now difficult to secure because Ballard actions were so popular among the target shooting fraternity that the frames were extensively used with barrels of other makes and gunsmith-made special stocks.

No. 3, Stevens rifle, schuetzen model. Mechanism like that of the "Ideal." Data is given under the heading of "Stevens."

No. 4, Wurfflein rifle. The top lever releases the catch of the barrel, which tips up at the breech. Manufacture discontinued.

No. 5, Sharps-Borchardt rifle. Unique in that the firing mechanism was contained in the falling breech block. An excellent mechanism, strong

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PLATE 15

and very speedy, and popular in its day. Discontinued.

No. 6, Remington rifle of the J. Rider or rolling breech type. Whitney rifle, rolling breech type. The same illustration serves for both as they are not differentiated in a small picture. Both discontinued.

No. 7, Hopkins & Allen rifle. Rolling breech, operated by the trigger guard. The Hopkins & Allen was the cheapest of the target rifles and yet, in the small calibres, as accurate as the best. But in the .22 rim fire size it was a nuisance because the empty shell could get inside the frame and block the movement. Discontinued.

No. 8, Buck rifle. Breech block, hammer and extractor operated by the trigger guard. Apparently an infringement of two other patents; discontinued before 1885. Made by H. A. Buck & Co., W. Stafford, Conn.

Plate 15

No. 1, Allen & Wheelock rifle. Ethan Allen's patent of 1860. Used rim fire 44 calibre copper cartridges. The breech action not being very strong, the issue of this rifle was discontinued about the time that improved center fire cartridges became common.

No. 2, Sharps rifle, Model 1874. This model differs, in the action, from its paper and linen cartridge predecessors only in the slight changes necessary for metallic cartridge ammunition. This specimen used the 40–65–330 bottle neck cartridge, which

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had a short vogue for 500 to 800 yard target practice. The same action carrying a heavier barrel was popular among the professional buffalo shooters in the Far West, and was made from about 1875 to about 1880 in the following calibres for such use: — .40–90–330, .45–120–550, and .50–105–520. These loads had considerable accuracy and speed, and tremendous shocking power, at half a mile and more; they also gave an awful kick, hence the thick barrel and weight for the rifle of 14 to 18 pounds. The factory price of such a rifle was about $100. The ammunition, in the Far West, averaged 25 cents per cartridge. The professional buffalo shooter usually shot from a prone position hidden on the far side of a hummock half a mile or further from the herd, in order that the buffaloes should be interested in and not alarmed during the antics of their stricken members. With a 25 power telescope on his rifle a skilled marksman frequently got every member of a herd of 25 to 50. A further adjunct to steady holding, furnished by the factory as part of an outfit, was a palm rest of interestingly immature design, which could be secured to the barrel or the fore end by a turn screw. There is one with the light rifle shown. The Sharps factory ceased business in October of 1881.

No. 3, Bullard rifle. Patent of 1886. Made by the Bullard Repeating Arms Co., of Springfield, Mass., for a short time. The rifle is extremely thin and reminds one of a caribou; seen sideways it looks full size and normal, but seen endwise it is hardly

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more than a line. However, the lines are graceful, the colors well chosen, the workmanship accurate, and the mechanism satisfactory; the reason of its failure lay elsewhere. The barrel is stamped .32–40, but it will not take an ordinary .32–40 shell. The accepted standard at that time of barrel boring for .32–40 ammunition was .319, but the Bullard people bored their barrels .311 to force the use of special cartridges of their make. Both barrel and cartridges were excellent, but trying to "buck" the market led straight to disaster. Discontinued about 1890.

No. 4, Phoenix rifle. Patent of 1874, model of 1879. The maker, Eli Whitney of Whitneyville, Conn., claimed it to have the fewest parts of any breech loader made. When first made the extracting device was inadequate; an improvement was designed by one of the partners of the Adirondack Arms Co., of Plattsburg, N. Y., and adopted by Mr. Whitney, and the specimen shown is so equipped. The Phoenix action was strong, but was of a class with the Hepburn, Snider and other single-movement actions, all of which were faulty because their first movement was across the head of the shell instead of away from it: hence when a primer was bulged into the mouth of the firing pin hole it was necessary to cock and snap the action to drive the exploded primer forward before it was possible to open the action. Arms upon the Phoenix model were discontinued about 25 years ago.

No. 5, Winchester rifle. This is a large and heavy made-to-order .22 calibre arm intended both

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for sporting use and for target practice up to 200 yards. It has made many 200 yard ten shot groups within a 6-inch circle with long-rifle cartridges The frame is the old model, not rabbeted on th sides, and having its principal large spring screwed to the under side of the barrel within the fore end. The mechanism was John Browning's patent; for further data see " Winchester in Part III."

No. 6, Frank Wesson rifle, sporting model, patented in 1859 and 1862. The forward trigger releases the barrel so that the breech end may tip up by hinging on the pivot below the barrel at the front end of the metal frame. In this early specimen the extractor is hand operated by pulling upon a knob which projects from the right side of the breech. The nose of the hammer can be removed and another substituted so that either rim fire or center fire cartridges can be used; this improvement was patented in 1872. The rifle illustrated is an extra good one with fancy Circassian walnut stock, highly polished, and silver plated metal elaborately embossed and engraved. On the left side the monogram made with the letters U. S. A. indicates, apparently, that the rifle was a present to an army officer. The calibre is .44; the weight 9½ pounds. Manufacture discontinued about 1885.

No. 7, Holden Rifle. Made by C. B. Holden, Worcester, Mass., about 1880. Previous to entering business under his own name, Mr. Holden had been foreman in the Frank Wesson shop. He was a rather prolific inventor and produced several dif-

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ferent breech loading devices, most of which were bizarre and impractical. The one breech loading rifle on which the bulk of his sales were based was the one shown. It tips up at the breech to load. Its peculiarities are: — its releasing and locking lever located on the right side of the *hammer;* and its barrel sleeve attached as a fore end to the frame, into which any one of a series of barrels may be slipped easily and quickly. Discontinued.

No. 8, Frank Wesson Rifle, No. 1 Creedmoor Long Range Model. The falling breech block action was patented July 10, 1877. The lever below the trigger guard operates the vertically moving breech block by means of a connecting rod; and the lever also, by means of a projection on its hinge end, operates the extractor. In this model the lock plate is set in the wood. From about 1877 to about 1885 Creedmoor rifles expressed the highest art of American makers of target rifles, and were capable of better shooting than people of the present generation can easily believe. Incidentally, they were rather expensive. This much engraved Wesson Creedmoor sold for about $200. The weight of this one is 9¾ pounds. Calibres were .44 and .45. The manufacture was discontinued about 1880.

No. 9, Frank Wesson Rifle, No. 2 Mid Range Model. The action is the same in principle as that of the No. 1, but the external details were simpler and the details of its make-up were less expensive in order that it might compete in retail price ($125) with other makes. The works of the lock are con-

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tained within the metal frame, the trigger guard swings to perform the functions of an operating lever, and the lessened amount of hand work necessary to the production and finish of the action tended towards reduced cost of production. When used as a mid-range rifle (600 to 800 yards) the ammunition was one of the following cartridges: 44–60, 44–77, or 44–90. A Creedmoor barrel was frequently owned as an extra to a No. 2 Mid Range frame. All Frank Wesson rifles were as accurate as the ammunition of the period permitted. The manufacture of the No. 2 Mid Range was discontinued about 1885.

No. 10, Peabody-Martini rifle, called the " What Cheer Long Range Model." The mechanism combines the patents of 1862 (Peabody) and 1868 (Martini). The Providence Tool Co., of Providence, R. I., were the makers, period about 1875. The rear sight is graduated to 1,200 yards, that being the limit of range for target practice for that time; and the reason for setting the rear sight close to the butt plate, on this and some of the other long range rifles, was that the rules of the National Rifle Association permitted the prone position in long range practice, in which position the marksman lay on his back and supported the butt of the rifle with the left hand passed behind the head, and the rear sight then was conveniently located for the right eye.

The retail price of this rifle was $125. All models of Peabody-Martinis were discontinued long ago.

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No. 11, Howard rifle. Patent of 1864. In America made by Howard Bros., Whitneyville, Conn., and in the shop of Geo. P. Foster of Taunton, Mass. By the British gunmakers who manufactured it it was christened The Thunderbolt. Its most striking characteristic is the absence in its outline of ordinary projections. It loads beneath the barrel in a recess exposed by throwing forward the trigger guard. One of the Howard brothers established the Dominion Cartridge Co. about 1885, and it is probable that the manufacture of this arm ceased before then.

No. 12, Smart rifle. DeMerritt Collection. Courtesy of Major John DeMerritt. This rifle, made by Eugene Smart, gunsmith and gunmaker of Dover, N. H., has a barrel tipping up at the breech, operated by a lever on the left side, following exactly the principle of the side lever in the old breech loading shotguns. The fore end can be detached instantly by pressing rearward on the stud which slides in the lower part of the tip; this is also an old-time shotgun feature. Both together put this single shot rifle in the unusual class. The calibre is 40–72. The period of manufacture was about 1898 to 1900, and the issue of this type was discontinued long ago.

No. 13, Hepburn-special rifle. This specimen is shown as an example of conversion, or perversion, if you will. The Hepburn part originally consisted of the rough drop forgings of a Hepburn action; the special part was all the rest. It was an amateur's

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own gun. The maker was an educated scientific chap with an inherited and inborn fondness for arms, considerable acquired mechanical skill, and an inexhaustible stock of patience when tinkering. For the sheer pleasure of it he not only made the rifle but also the tools for making it. The good taste of some of the silver inlay may be questioned, but the lines, colors and workmanship are up to average professional grades. Of course the size, length and drop of the butt caused a " custom made " fit to that especial person. The rifle was made at the time the newly designed 28–30–120 ammunition was drawing pæans of joy from the shooting fraternity. No better small bore black powder cartridge was ever in use, and the rifle happened to handle it to a nicety; with sand bag rests and the Lymans shown on the gun it did some noteworthy feats on a sheltered range in the forest country of the North.

One early October morning, just after a shot had been fired at random to soil the barrel, a typical old backwoodsman with whiskers and rheumatism came out of the woods and silently took position behind the firing stand. On the stand were bright, new bullets, all extra good, and all previously creased by passing them butt end first through the clean barrel; envelopes holding each a weighed charge of powder; cardboard wads; one clean shell; and tools and things. The old man looked, and evidently he wondered, but he was shy and silent. The rifleman nodded a " Good-morning " to break the ice, and

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proceeded to seat a bullet through the chamber into the rifling, pour a charge of powder from its envelope into the shell, aim carefully so that an even margin of white target should show around the front sight, and fire.

After five shots the old man enquired "Wutcher shutinat?" "At that piece of paper on the sand-box." "Way out there? Air ye a hittin' ovit?" "Don't know. I can't see bullet holes so far. That is a hundred yards." The old man spat a long stream of tobacco juice at a knot on a post and hit the knot. "Les gosee." They went together slowly, through the dewy grass, and the old man remarked shyly that he used to like to shoot but didn't see much good shooting nowadays; new-fangled guns weren't so good as what he used in his younger days. When they got close to the target they saw only one hole in the paper. The old man got slowly and stiffly down on his knees in front of the target and peered at the hole with five scallops on its edge like a silhouetted five-leaved clover. Then slowly he reached deep into his pants and drew out a buckskin bag, from which he selected, after due deliberation, a nickel. He applied the nickel to the hole, completely covering the hole. Then slowly he looked up, and when he caught the shooter's eye he expressed a whole lot of meaning with just these few words — "Wal, I snum! thet 'ere gun's a reglar do-dab."

Target shooting with single shot rifles as an universally popular American sport passed away with

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the last decade of the nineteenth century. The use of single shot rifles for game shooting waned at the same time, for the advantages of the repeater were not to be ignored. A popular sporting writer of that period, whose influence reached far and wide, clinched the last nail in the coffin of the single shot when he wrote: "I was hunting in Dakota several years ago, and made for a small river. I crept through the cotton-wood growth which fringed the banks, hoping to get a shot at some geese which I noticed had dropped into the river. Suddenly, from the opposite bank of the river, there was a mighty rush, and a deer plunged wildly up the bank. I had a Maynard rifle in my hands, and shot and missed the deer. It reached the top of the opposite bank and stopped, side towards me, presenting a silhouette figure and a fine shot. It was very cold, and I was heavily clad with a thick reefer, which was buttoned snugly about me, had on buckskin gloves, and my cartridges were in an outside pocket. Before I could reload my rifle the deer had disappeared, and I was muttering, 'If I only had a repeater.' This incident, with several others, convinced me that many times a person will lose game if he is armed with a single shot rifle which he could secure if he had a repeater;" and the few remaining manufacturers of single shot rifles realized that they must either specialize on repeaters or go out of business. At the present time, 1920, except a certain single shot rifle made for armory use, the demand for which has been vastly increased by the

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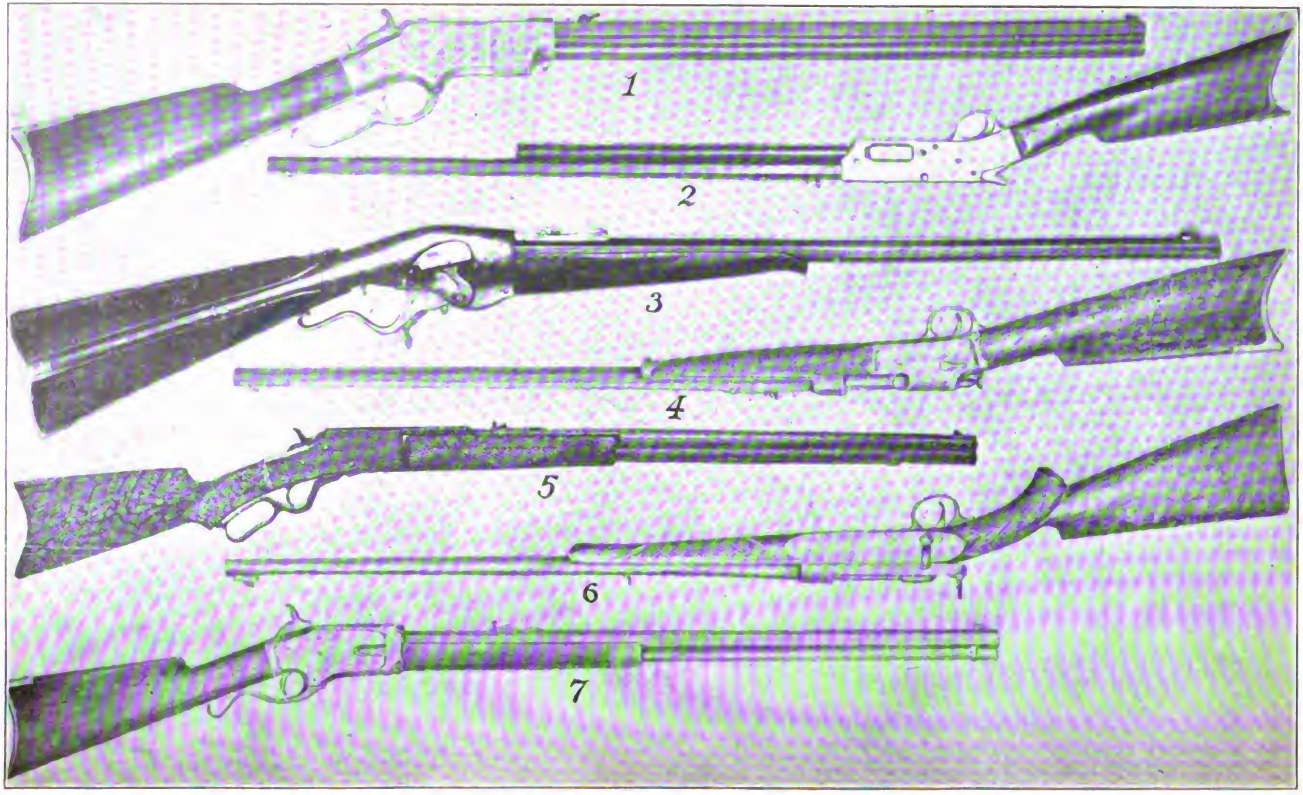

PLATE 16

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war, and except the cheap toys made as catch-pennies for boys, the sale of single shot rifles is next to nothing. Probably the revival will occur along the line of a first-class bolt action military gallery rifle.

The foregoing statement of disuse and replacement should not be misunderstood to mean that there was a definite date of departure of the single shot and arrival of the repeater. No day, month or year marked the time. Match and wheel lock arms continued in use well into the flint lock period; flint lock and cap lock arms served brother sportsmen on the same day in the same field; and regiments of soldiery used flint and cap lock military arms even into the Civil War; repeating metallic cartridge rifles, as we soon shall see, struggled for their place in popular favor way back when the single shot was in the heyday of its use.

Metallic Cartridge Repeating Rifles

Plate 16

No. 1, Henry rifle. Tyler Henry's patent, 1860. Made by the New Haven Arms Co. from 1860 to 1866, when, with King's improvement, it became the Winchester rifle. For further data see Winchester.

No. 2, Adirondack rifle. O. M. Robinson's patent of 1872. Made by the Adirondack Arms Co., Plattsburg, N. Y. A very good arm, similar to the Winchester in principle but different in mech-

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anism. Business purchased about 1875 by Oliver F. Winchester and thereafter discontinued.

No. 3, Evans rifle. Warren R. Evans' patent of 1871. Made by the Evans Repeating Rifle Co., Mechanic Falls, Maine. The magazine, holding from 26 to 32 cartridges, was a large steel tube on which the top and bottom parts of the butt were fastened. Within the magazine a helix, revolved by the movement of the trigger guard, fed the ammunition to the chamber without the use of a spring. Discontinued about 1885.

No. 4, Hotchkiss rifle. The illustration shows the usual sporting form of this arm, which was made in greater quantities in the military models. See Hotchkiss military rifle and carbine, and Winchester. Discontinued about 1900.

No. 5, Bullard rifle. Made by the Bullard Repeating Arms Co., Springfield, Mass., for a few years. Discontinued about 1890.

No. 6, Blake rifle. The period of manufacture was about 1898 to 1900. It seemed to be an excellent arm, and its discontinuance doubtless was due to some other cause than itself. Its seven high power cartridges, held in a cylindrical revolving packet, were charged into the magazine, packet and all, in a block; and the rifle was very speedy in action.

No. 7, Burgess rifle and Kennedy rifle. These arms, patented in 1879, so much alike in appearance that the same picture serves for both, were made for a few years by E. Whitney, Whitneyville, Conn.,

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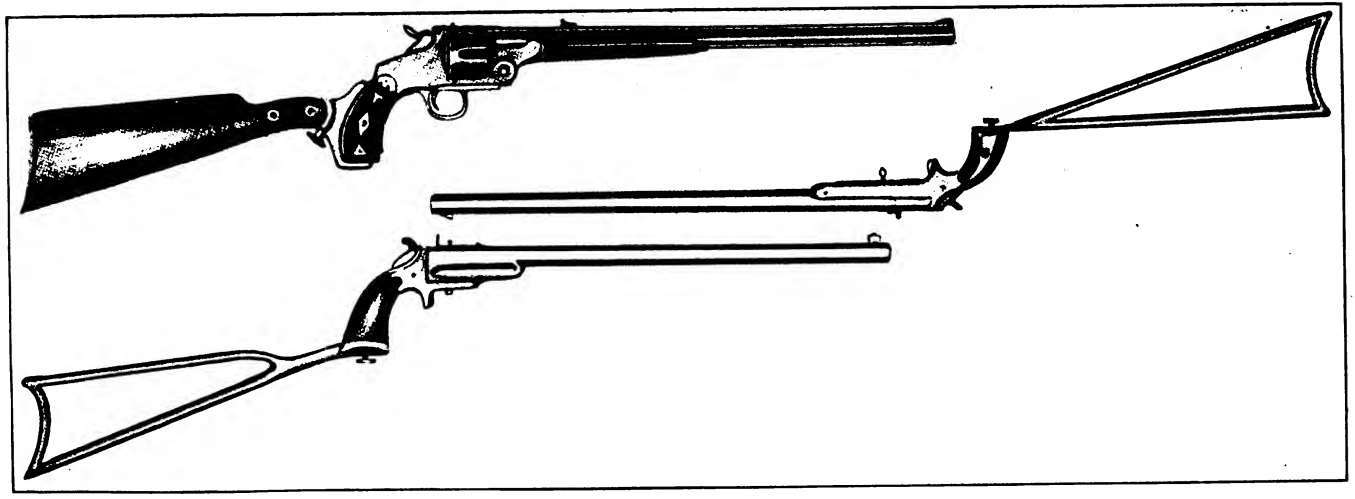

PLATE 17

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and by the Colt Patent Fire Arms Co., Hartford Co., Hartford, Conn. They did not prove to be sufficiently able competitors with others of their kind.

For the past and present rifles of firms still doing business, see Part III.

Aberrant Metallic Cartridge Rifles

Plate 17

No. 1, Smith & Wesson pocket rifle. Made from about 1880 to about 1885. The detachable stock had a very powerful fastening to insure its firmness. The quotation which follows is from a sporting goods dealer's catalogue of 1880: "6-shot, .32 calibre extra long centre fire shell made expressly for this arm. The only small calibre metallic cartridge repeating rifle in the world. We can state from experience that it is the most marvelous shooter we ever handled. It will shoot accurately 300 yards, and we have put 23 successive balls in a four-inch circle at 110 yards. Its wonderful accuracy is due partly to the new peep and globe sights which are made especially for this rifle. The globe sight is a magnifying crystal inside of a short tube; in the exact center of the crystal is a black dot, making the finest sights ever put on a firearm of any kind. It has a set trigger, and with the sights full on a squirrel at 150 yards it would seem almost an impossibility to miss him. The person owning this rifle can outshoot the whole community. Every one is packed in a leather case worth at least $4.00 free of charge."

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Granting the wonderfully high grade of workmanship on all Smith & Wesson arms, is it too pessimistic to enquire how much profit was necessary to extract from a dealer such a sweeping encomium? The retail price was $25. Anyway, the statement, considered merely as advertising matter, is interesting. How very odd that such a remarkable repeating rifle should have had such a short life.

No. 2, Frank Wesson pocket rifle, old model. Made prior to 1871. Barrel tipped up at breech; the releasing catch was on the underneath part of the frame and operated in the same manner as the forward trigger on the Wesson tip-up regular rifle.

No. 3, Frank Wesson pocket rifle. When introduced it was called "New Model," and the catalogue name for it was "Sportsman's Jewel." The patent for it was granted in 1870, and it was made from then to about 1890. By pressing a stop under the frame the barrel could be turned over to receive a cartridge or eject an empty shell. Barrel lengths were furnished regularly between 10 and 20 inches. Calibres were .22 and .32. Retail prices ran from $12 to $17.

See also Part III.

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Part II. MILITARY RIFLES

Chapter I

U. S. Military Rifles From 1800 to 1920

Plate 18

No. 1, Model 1800 Rifle. Regulation.

Although, in the very founding of the United States, regiments of volunteer civilian infantry, armed with their own Kentucky rifles, proved again and again infinitely superior in battle to regiments of veteran soldiers armed with smooth bores, nevertheless the new United States let nearly twenty-five years go by before attempting to make military rifles.

But the prospect of war with France, at the close of the 18th century, awoke the martial spirit of the new little nation, and revived old romantic tales of the days of 1775 to 1783. Memories awoke to the feats of skill of the "Mid Colonials," feats which had seemed so remarkable not only to the trained British soldiery, who were their opponents and victims, but also to that other part of the American Army which had been armed with just muskets. Whereupon Congress in 1799 passed an act authorizing the addition to the regular army of "A Rifle Regiment." And, since our regular army, a mere

The courtesy of Major Charles C. Foster, M. D., is gratefully acknowledged for permitting the comparison, by picture and examination, of arms in the Sawyer Collection with arms in the specialized Foster Collection of U. S. Military Arms. There being no previous compiled data of any moment to serve as a basis for this work, the cross-checking was of great value in eliminating errors. This applies to carbines as well as to rifles.

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handful of soldiers then known as the "Military Peace Establishment," was supplied with arms made in government shops, it was a logical outcome that the new rifle regiment also should be supplied with rifles made in the shops of the government.

The birth of our first military rifle required about a year. The issue was a cross between the heavy carabine of the French, the short gewehre of the Germans, and the strongly individual American all-purpose rifle. That Model 1800 rifle was, and it still is, a curiosity. In ballistic qualities it was also, according to the old saying, "a mixed breed of cats." Accuracy, high speed and low trajectory were expected of its bullet. But with its relatively short barrel, to burn all of its large charge of powder it was necessary to use powder of fine grain; that caused tremendous recoil, which, in turn, induced flinching and consequently inaccurate shooting. So our first military rifles embodied a portion of the bad qualities of the German rifle which was the prototype of the Kentucky, and were, instead of a modified Kentucky, of a perverted Kentucky type.

As the expected war with France failed to materialize, the first mention of any distinguished service performed by this model of arm is contained in a record of the Lewis and Clark Expedition, which in 1804 left St. Louis to explore the new Louisiana purchase. The members of this party, besides the leaders, consisted of forty men, half of whom were trappers and voyageurs armed with their own Ken-

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tuckies, and half of enlisted men of the regular army armed with " the new short military rifle."

The scarcity of Model 1800 rifles at present in collections, dated earlier than 1812 War time, probably indicates that a few per year were sufficient to equip the slowly forming " rifle regiment." The earliest of these arms which is widely known is in the Pugsley Collection and is dated 1803.

Considering the individuality which is necessarily expressed in the output of various workmen following a model merely by sight and rough measurements, and permitted latitude according to their abilities, the 1803 specimen, and others of succeeding years, and the specimen illustrated, which is dated 1814, all undoubtedly are intended to be of one model. There are, however, considerable variations. For instance: while the calibre remained constant to the extent of using a half ounce ball, the styles of boring and grooving seem to have been left to the choice of each individual barrel maker, perhaps because the arm was for many years in the experimental stage. One specimen has an heptagonal instead of a circular bore; and, among many others, no two have lands and grooves exactly alike, but are found of almost every imaginable shape, depth and pitch. Different lengths of barrels also occur, varying from 32 to 36 inches: and some of these rifles were equipped with set triggers, while nearly all of them were made with plain triggers: but these details evidently belong in the " made-to-order " class, and were individualities granted the

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requests or demands of certain noted marksmen who enlisted; for in those days a noted rifleman was a little king who honored the service by enlisting in it, and it was necessary to placate him to get him.

All Model 1800 rifles were marked on the lock plate with the date of manufacture, Harpers Ferry, and a spread-eagle bearing U. S. on a shield. The specimen illustrated is dated 1814. Its total length is about 4 feet $1\frac{1}{4}$ inches; the length of its barrel is $33\frac{3}{8}$ inches. It was called .54 calibre, but as the grooves are each 4 one-hundredths of an inch deep the real calibre is .62. However, like other .54 calibre rifles, it used a half ounce ball, the diameter of which was .525, and the difference was adjusted by the thickness of the patch. There are seven grooves with pitch of one-half turn in $32\frac{3}{4}$ inches, which is the distance from the flat front end of the breech pin, which is flush with the rear of the touch hole, to the muzzle. The workmanship of the inside of the barrel is nowhere near up to that of the best Kentuckies of the same period; the bore is slightly untrue and the lands are not all of the same width, the cause of the latter being either poor construction of the rifling machine or wear in its moving parts; and the edges of the lands are too sharp — sharp enough to cut the patch to pieces as soon as the bore became reduced by fouling. There is no formed chamber and the grooves run to the breech pin. The official charge for the Model 1800 rifle was 90 to 100 grains of fine grained rifle powder and a half ounce pure lead ball loaded with a greased

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patch of either linen or buckskin. The muzzle velocity was about 2,000 f.s. The trigger pull is about 7 pounds. The rifle and its steel ramrod weigh 9¼ pounds.

This specimen apparently never had much wear and the finish of its exterior may be the same as when new, barring the darkening produced by age. The wood was filled and then coated with successive rubbings of linseed oil until it became slightly polished. The furniture, which is of brass, was polished bright; the lock, trigger and ramrod, all made of steel, were also polished bright. The ramrod is threaded for a wormer on the small end and at the head end slightly cupped to fit the ball. The barrel, rear sight, rod thimbles and the iron rib to which they are soldered were treated with chemicals until they became a rich plum-brown. The brass cover of the patch box opens by pressure upon a spring-stud set into the top of the brass butt plate. The small and simple sights do not permit any sort of adjustment for distance or drift but are rigidly fixed; their relation to the bore indicates that they are set for 50 yards.

Model 1800 rifles were used wherever and whenever there was trouble with the Indians, by the navy to some extent in the expeditions against the West India and Barbary pirates, in the War of 1812, and, in a small degree, in the Mexican War of 1847. They were made until 1819, when their manufacture was discontinued and Model 1817 rifles were issued instead. The number made is unknown, as the

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records of the Harpers Ferry Armory were destroyed at the beginning of the Civil War and no duplicates have ever been found. From time to time attempts have been made by army officers and others to reproduce the Harpers Ferry records from fragmentary outside sources and compile tables of the arms made there in the first quarter of the 19th century. Such lists are both incomplete and inaccurate; they omit arms from years when existing specimens show that they were made; and they exaggerate the number made there during certain years by incautiously jumbling Model 1800 rifles, Snipper rifles, Wall pieces, Whale Guns, and barrels only which were furnished both to contractors and to militia companies, all in one list. At present there is but one certainty as to their number and that is that it was small; for during the War of 1812 it was necessary once more to have recourse to citizen soldiery armed with their own Kentuckies.

No. 2, Officers' Model 1800 Rifle. Regulation. As the officers of a rifle regiment carried rifles instead of swords the government provided them with weapons slightly lighter in weight and somewhat more ornamental in respect to engraving, checkering and the shape of small parts than the arms of the enlisted men. Otherwise the specimen shown follows the generalities of No. 1.

No. 3, Rampart Rifle. Called also Wall Piece. Regulation.

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These heavy, large bore rifles using a ball from three-quarters of an inch to an inch and a quarter in diameter were made at Harpers Ferry in 1806 and 1807, and probably also before and after. They weighed from 20 pounds upward, and were used principally on the ramparts of wooden forts scattered along the frontier.

In building a frontier fort if a strategical position was not already in the midst of a large open area, all trees, bushes, and bowlders that might offer cover to the savages were cleared away for a distance exceeding ordinary rifle range. These rampart rifles, with accurate range about double that of shoulder rifles, therefore gave the defenders of the fort considerable advantage.

Contract-made rampart rifles were in use by the United States before 1800. In a tabulation of military stores made in 1802, 465 rampart rifles, not including those in use, were listed. During the Civil War very heavy rifles, under different guise, reappeared for military use. See "Snipper Rifle" of 1861 to 1865 described further along.

The flint lock rampart rifle illustrated has a rear sight which is adjustable both horizontally and vertically, with set screws to hold it. Between this sight and a type developed in Switzerland during wheel lock days there is so strong a resemblance as to indicate a considerable knowledge of arms on the part of the political appointee who at that time was in charge at the Ferry Armory.

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No. 4, Model 1817 Rifle. Regulation.

Marks: "Harpers Ferry, 1817" and a spread-eagle with U. S. underneath. Total length about 51½ inches. Length of barrel about 36 inches. Calibre of bore without grooves .52. The bore is heptagonal and the seven narrow grooves are at the apices. Of course they are quite unnecessary. The depth of the grooves is one-hundredth of an inch. The pitch is one turn in 50 inches. Weight of the rifle with its steel ramrod 10 pounds. It was not at first supplied with a bayonet, but later a ten-ounce socket bayonet was issued with it for certain special demands of service. The charge was 90 to 100 grains of fine grained powder and a half ounce spherical bullet loaded bare. Loading became difficult after fouling accumulated. The muzzle velocity was about 2,000 f.s.

The original finish was — wood not filled but treated with several coats of linseed oil; polished brass pan; bayonet and ramrod polished bright; all other metal, which was iron or steel, heat blued except the barrel, which was browned, and the frizzen, which was case hardened gray.

The ramrod has a threaded small end and a cupped large end. The patch box was furnished with a paper wrapped parcel containing a wormer to screw on the ramrod, a combination screw driver with a lever for turning the jaw-screw, and a piece of machine-stamped sheet lead called a "flint cap" correct in size and shape to help hold the flint in the jaws of the cock. The rear sight is similar to that

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on the Model 1800; the front sight is on the front band; they seem to be set for 50 yards.

The workmanship of the exterior, and of the lock, rivals that of a fine sporting rifle. The interior of the barrel is but little, if any, better than that of the preceding model; but there is a formed chamber, which possibly is a slight improvement. The specimen described is in nearly new condition.

This rifle was, according to contemporary statement, expected to place about 30 per cent of its shots in a 10-inch circle at 200 yards; this was when fired from the shoulder with a rest and included the errors of the rifleman, which may have equalled those of the rifle. This particular specimen probably was incapable of that amount of accuracy, but the rifles modeled on it and made by contractors were better bored and grooved and may have fulfilled expectations.

In addition to 7,817 believed to have been made at Harpers Ferry and 250 made at Springfield Armory in 1819, many thousands of Model 1817 rifles were made between 1820 and 1830 by contractors S. North, N. Starr, and R. &. D. Johnson, all of Middletown, Conn., and H. Deringer of Philadelphia. The price paid for each averaged close to $14.50; money was valuable in those days; in present currency the price would amount to about $100.

These rifles have, erroneously it appears, been called Model 1819. The date on the specimen illustrated sets the model 2 years earlier. Those made in the government shops were issued to the

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regular army and also sold to the states for issue to militia. It is believed that all that were made by contractors were issued only to militia. Model 1817 rifles served against Indians, and in the Mexican War, and in the first year of the Civil War on both sides. In the Civil War both the North and the South used flint lock and other antiquated arms in the beginning of the struggle.

No picture. Officers' Model 1817 Rifles. Regulation.

Specimens and data lacking.

No. 5, Model 1819. (*Breech loading.*) Regulation.

Marks: "J. H. Hall, H. Ferry, U. S. 1838." Total length about $53\frac{1}{8}$ inches. Length of barrel about $32\frac{5}{8}$ inches. Calibre of bore without grooves .50. Depth of grooves two-hundredths of an inch. Number of grooves 16. Pitch 1 turn in 8 feet. At the muzzle the lands are reamed out for a distance of an inch and a half, which is as far back as the rear edge of the front sight; looking into the muzzle the rifle could easily be mistaken for a smooth bore. Presumably the object was to facilitate loading at the muzzle in case the arm became defective as a breech loader. Possibly it was intended to increase accuracy; in either case the depth of reaming seems excessive.

The rear of the bore is funnel-shaped to prevent the ball being sliced when it enters from the movable

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breech. A space equal to the thickness of a sheet of writing paper was left between the front of the movable breech and the rear of the barrel for the accumulation of powder residue. The gas leakage was considerable and there was some loss of power.

Without bayonet the weight of the rifle was 10 pounds; with the socket bayonet, 10¾ pounds. The charge was 100 grains of rifle powder, and 10 grains more were used for priming. The bullet was spherical and weighed ½ an ounce; its normal diameter was .525; it was shot bare. Owing to the escape of gas at the breech the muzzle velocity was several hundred foot seconds less than that of Models 1800 and 1817. Ammunition was furnished to the soldier in the form of paper cartridges, and up to about 1830 he loaded the rifle by biting off the end of the paper, pouring the powder into the breech, pressing in the bullet with his thumb, and using the paper for a wad, or discarding it if he chose. Later the paper envelope was made combustible with nitre and the cartridge then was thrust into the breech entire.

This specimen, apparently never used, gives the following data as to its original finish. The pores of the wood were not filled and the surface received the usual protective coatings of linseed oil. The breech block and the external lock parts show dull colors of case hardening. The ramrod and bayonet are of polished steel. All screw heads are blued. The barrel and all other steel or iron is coated with brown lacquer. As lacquer does not appear on

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U. S. government arms after the destruction of the Harpers Ferry works in 1861 presumably the formula was lost with the other burned records, because this lacquer is an admirable preservative and of excellent wearing qualities; it is not affected by water, oil, or acid; it is tough, hard, and so adhesive that it can only be removed by scraping.

The Hall breechloader was the first regulation army rifle loading at the breech. Its inventor was John H. Hall, of Yarmouth, Maine, who patented it in 1811. During the next five years he produced a few fowling-pieces, pistols, and sporting rifles, on this principle, and earnestly besought the government to adopt his invention. In 1816 the government decided to try it, and during that year 100 were made and issued for trial. They proved satisfactory, and so during 1817 another lot of 100 was made, but these were made percussion to test the copper cap invention of Joshua Shaw. These 200 rifles were hand made, their parts were not interchangeable, and their general appearance differed slightly from that of the specimen illustrated, but their operating principle was the same.

The government having decided to use these rifles in quantities, accepted the inventor's suggestion to make them by machinery with parts interchangeable, and a model piece was constructed like the one illustrated, and in 1819 officially adopted. But the invention and construction of the requisite machinery occupied a considerable time, so that the first thousand Model 1819 rifles was not finished until 1825.

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Thereafter they were produced constantly at the Harpers Ferry works until 1840.

Meantime, in 1828, the government contracted with S. North for 5,000, and in 1829 with Reuben Ellis, of Albany, N. Y., for 500, to be made exactly like the Harpers Ferry ones. Those produced at the Ferry cost the government about $21.00 apiece; Mr. North, however, was paid only $17.50 each, and this price included bayonet, flint, wiper, bullet mold, screw driver, and spring vise.

Model 1819 rifles were used to considerable extent in the Black Hawk, Seminole, Mexican, and Civil Wars; previously a few had been used unofficially in the Creek War of 1813.

No picture. Officers' Model 1819 Rifles. Regulation.

Specimens and data are lacking.

No. 6, Four Shot Repeating Rifle, 1824, and *Five Shot Repeating Rifle, 1825.* Militia.

These multi-shot superposed load flint lock rifles, made for New England militia companies, were produced by Simeon North of Middletown, Conn., by altering his overstock of Model 1817 rifles which he had been making for the government. The alteration consisted of substituting for that part of the regular rifle behind the rear band a screwed-on barrel piece provided with a number of touch holes and a brazed-on slotted side plate. In the slot of the side plate a complete, boxed-in flint lock of

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pistol size could travel between the various touch holes. Its sear was tripped in any position by a bar acting on the parallel ruler plan and operated by a single trigger.

This means of firing a number of loads from one barrel was old and widely known (see 4-shot repeating flint lock pistol, Vol. 1), but perhaps its application to military rifles was new. It was an unsound invention. See Lindsay rifle, described further along.

No picture. Harpers Ferry Rifle Model 1832. Experimental.

In 1832 nine model rifles were made at the Ferry works. Specimens and data are lacking.

No. 7, Jenks Rifle, 1838. Regulation.

Breech loading percussion rifle; Wm. Jenks' patent of 1838. Made for navy use and if issued to the army no record has been found. The first contract for these arms was let to the N. P. Ames Company of Springfield, Mass., who produced them with the simple side action capping lock shown in the picture.

The paper cartridge was introduced at the breech of the barrel by raising and swinging backward the lever lying along the top of the grip; and since the rifle was advocated for rapidity of fire no ramrod was provided for loading at the muzzle. Wiping rods for cleaning Jenks rifles after an engagement were carried aboard ship. There was no bayonet.

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No. 8, Model 1841 Rifle. Regulation.

The Model 1841 was the first U. S. Government infantry rifle with percussion lock. It was also the first which, in recognition of the fearful kick of our former military rifles, used a reduced powder charge for the old style half-ounce ball, thereby raising the trajectory. The Model 1841 also marked the end of all our flint lock military arms. The last of such flint locks — smooth bores — made in the government shops were finished in 1842, and the percussion lock was officially adopted then. From 1842 on, the stock of all varieties of flint lock arms on hand was gradually altered to cap lock; those altered up to 1851 were mostly for experimental purposes; later, and especially during the Civil War, great quantities were altered for use.

The Model 1841 rifle was noteworthy also for being the best made and most accurate spherical bullet military rifle in the world; all nations so acknowledged it, and it so remained until the spherical bullet was superseded by the conical one; then the boring and grooving of the barrel had to be revised to meet the new conditions and the model was superseded by a new one. Its supremacy lasted for 14 years. During that time the government works at Springfield and Harpers Ferry produced several thousand, and several thousand more were made by contractors Whitney, Tryon, Remington, and Robbins & Lawrence. These contract arms were mostly turned over to the states for militia use.

By civilians the Model 1841 was considerably

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used for big game and Indian shooting in the Far West. Its accuracy and shocking power so strongly recommended it that it was nicknamed "Yerger," dialect for Jäger, hunter. By military men it was variously called "Harpers Ferry Rifle," "Mississippi Rifle," and, later and erroneously, "Model 1842 Rifle." This last was from the year the percussion system became official.

The specimen illustrated is well designed and the workmanship both inside and out was admirably executed. It is marked "Harpers Ferry Model 1841," and each separate piece is stamped "U. S. M.," for United States Model. The total length is 4 feet and ½ inch; the barrel length is 33 inches. The bore without grooves is .52; the grooves at the muzzle are 5 thousandths of an inch deep and they increase regularly in depth to 13 thousandths at the breech; there are 7 of them, almost semi-circular at the breech, segmental at the muzzle, about two-thirds the width of the lands, and having a pitch of one turn in 6 feet. The weight of the rifle is 9¾ pounds. When new it was not provided with a bayonet.

The charge was a half ounce spherical bullet, patched, and 75 grains of rifle powder. The muzzle velocity was about 1850 foot seconds. At that period in making up fixed ammunition in the government shops for the Model 1841 and its flint lock predecessors still in use the bullet was enveloped in a square piece of cloth, or soft, thin wash leather, or bladder, and all the puckers were gathered and

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tied and trimmed; then the entire surface of the patch was saturated with tallow. The bullet, with its pucker to the front, was then put into the open end of a cylinder of paper containing a charge of powder; the end of the cylinder was choked over it and the whole was fastened with three turns and a double hitch of linen thread. Until nitrated (combustible) cartridge paper came into use this sort of cartridge was torn open before loading, the powder and bullet loaded separately, and the paper thrown away.

Between 1849 and 1855 conical, hollow base bullets were issued for trial with these rifles. The bullet grooves were filled with a mixture of beeswax and tallow. The powder charge was 50 grains. Besides the 390 grain bullets, 417 grain ones were also tried, like the 390 grain ones outside, but having the base cavity conical.

The finish of the Model 1841 rifle illustrated seems to be the original finish and is — acid browned barrel; heat blued trigger, screw heads and band springs; exterior lock parts case hardened gray with faint mottled colors; bright polished ramrod and sling swivels; polished brass furniture; dull, oil finished wood.

In spite of the increased trajectory the sights are rigid and set for 50 yards. The front sight is not on the band, as with the preceding model muzzle loader, but set into the barrel one inch from the

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muzzle; it is of brass, and thin, so that when seen through the fine slot of the rear sight there is a space of light each side of it.

This rifle, at 100 yards, in the hands of a good shot, and not using service ammunition but using bullets with loose patches, was probably capable of making an occasional 10 shot string in a 4-inch circle. The penetration with service ammunition at 100 yards was through 8 inches of soft pine.

No. 9, Variant Model 1841 Rifle. Regulation.

The front band is considerably lighter, slightly lessening the muzzle heaviness that is to a considerable degree noticeable in all Model 1841 arms. As first issued no bayonet was provided. The specimen rifle shown was made by Tryon of Philadelphia, contractor.

No. 10, 2d Variant Model 1841 Rifle. Regulation.

The contractor for this specimen was Eli Whitney, of Whitneyville, Conn. Although dated in the forties it has a lock and a butt of shape not issued by government shops until Civil War time.

During the forties the accoutrements issued for all Model 1841 rifles consisted of —

Cartridge box of leather, size outside about 7 inches wide, 5 inches high, 1½ inches thick, lined with tin, having 5 compartments above and 2 below;
Leather sling strap for the rifle;

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Leather pouch weighing 13 ounces in which to carry a ball screw, cone picker of steel shaped like a large needle, tip for the ramrod, pieces of cloth to go on the tip for cleaning the bore, a box of grease, and presumably also a box for caps, although the latter was not mentioned;

A copper powder flask size 7 by 4 by 2 inches holding half a pound of coarse powder and provided with two carrying rings.

Model 1841 rifles had military use against Indians and Mexicans; and a few, still of .54 calibre, were used in the Civil War; but by that time nearly all had been altered to .58 calibre and provided with lugs for attaching sword bayonets. Both the Tryon and the Whitney rifles illustrated had been so altered. During the Civil War and for a few years after many Model 1841 rifles were sent to the shops of various contractors to be altered to breech loaders by the Merrill, Miller, Lindner and other systems.

A surprising number of duels was fought by civilians with Model 1841 rifles in the period from 1850 to 1865. They were matters of record in the newspapers of the time. Even more surprising were the few casualties.

No picture. Model 1842 Rifle Musket. Experimental.

In 1842 a number of muskets made in the government shops used the same kind of lock, cone and cone seat which were used for the Model 1841 rifle. They were otherwise just like the Model 1840 smooth

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bore flint lock muskets. A few of these arms were rifled for experimental use; they were calibre .69, and fired a 730 grain spherical bullet and 70 grains of powder. No specimen was available for illustration.

Plate 19

No. 1, 1842 Conversion of Model 1822 Musket to Rifle Musket. Regulation.

The change from flint lock to percussion arms became official in the United States in 1842. During this year, and later, several hundred Model 1822 smooth bore .69 calibre muskets were altered to percussion rifle muskets by converting the locks, grooving the barrels, and adding rear sights. As the barrels of Model 1822 muskets were thick enough to be grooved lightly without unduly weakening them, this easy method of converting obsolete muskets was considerably practised during the early part of the Civil War to help overcome the shortage of arms, even though the spherical bullet which they used had become out of date. The date of conversion was stamped upon the breech of the barrel.

As a flint lock musket the charge had been a ball of 18 to the pound and 130 grains of powder; as a rifle musket the charge became a ball of 17 to the pound and 110 grains of powder. There were 7 grooves.

Before these data were determined a good deal of experimenting had been done. Various pitches to

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PLATE 10

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the rifling had been tried between 1 turn in 10 feet and 1 in 6 feet. The first alteration to cap lock was made by screwing the cone into the barrel; the second by screwing a plug into the touch hole and seating the cone in the plug; the third consisted of brazing a lug on the barrel to take the cone; and a fourth consisted in cutting off the breech of the barrel and screwing on a new breech which had a chamber of less diameter than the bore of the barrel and a ledge around the outer edge of this chamber for the ball to rest on. This last was the Delvigne breech invented in France in 1826; its purpose was to allow the use of a ball of smaller diameter than the bore, dropped down the barrel until arrested by the ledge, then expanded to fill the barrel by blows given with the iron ramrod. The pillar breech, invented by Thouvenin in 1846 as a better means of accomplishing the same purpose, is not on record as having been used by our government, although it was known at our armories.

No picture. 1854 Conversion of Model 1822 and Model 1842 to Rifle Musket. Regulation.

In externals similar to No. 1, Plate 19. From 1854 to the end of the Civil War when time permitted a better method of converting flint lock muskets was followed. This consisted in reducing the calibre to the prevailing one of .58 by brazing a lining tube in the barrel. The converted arm then used the same powder charge and kind of bullet as the newest arms. In external appearance No. 1, Plate 19, is

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correct for this conversion, all but the ramrod, which should be like that of the Model 1855 arm.

No picture. Harpers Ferry Sharpshooter Rifle Model 1847. Regulation.

No specimen available for illustration and no other data than — calibre .75; peep sight on hammer; globe front sight; heavy rifle to be used on a tripod which was made for and furnished with it. Few made.

No picture. Sharps Rifle, 1846 or 1847. Militia.

Although the patent for Sharps rifles was not issued until 1848 records indicate the use of them in the Mexican War of 1846–47. Data lacking.

No. 2, Model 1855 Rifle. Regulation.

In 1854 the United States began preparations for superseding in 1856 the smooth bore with the rifle for all branches of the service. Also the principle of the hollow base conical bullet expanded within the barrel by the action of the powder gasses upon an iron wedge within the bullet, developed by Captain Minié in 1847, was, after experiments in the United States since 1849, improved upon at the Harpers Ferry Armory by the discovery of the Assistant Master Armorer (Mr. Burton) that an expander-plug was unnecessary, because the gasses from the explosion sufficiently expanded the hollow base without it. This type of bullet was adopted and used thereafter in all newly made muzzle loading rifles.

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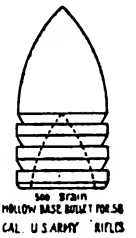
The rifle illustrated is marked "Harpers Ferry 1860." Its length is about 4 feet $1\frac{1}{8}$ inches; its weight without bayonet is about 10 pounds. The calibre is .58, using a hollow bullet of 500 grains and 60 grains of powder. The muzzle velocity was about 950 f.s. The pitch of the rifling is one turn in 6 feet, uniform twist. There are 3 grooves each .3 of an inch wide, .005 of an inch deep at the muzzle, increasing regularly in depth to .015 at the breech. The stock was coated with linseed oil but not polished; the metal parts, all of steel, were polished bright, except that a few of these rifles were issued for trial with barrels coated with a brown varnish made in the proportions of $\frac{1}{8}$ ounce of dragon's blood, 1 ounce shellac, dissolved in 1 quart of alcohol.



The Model 1855 rifle was fitted with a sabre bayonet engaging with the lug to be seen on the right side of the muzzle; and from 1855 to the end of the Civil War, preceding models of U. S. rifles, when found stored in considerable numbers, were also fitted with bayonets of either the sabre or the socket rapier type.

The characteristic of the Model 1855 rifle which most strikes the attention is the Maynard Priming Magazine, this being the first military rifle to be fitted with it. When all conditions were at their best this automatic magazine primer worked excellently and when first applied it was considered a

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wide step forward in celerity of fire. The cover showing on the lock plate could be opened by swinging it forward upon a hinge, to expose a cavity into which to place a coil of narrow, water-proof paper having many pellets of fulminating powder spaced at regular intervals. A simple mechanism within the cavity was operated by the movement of the hammer to uncoil the paper (called " tape ") and feed one pellet at a time exactly upon the top of the cone. Refer to Plate 4, No. 7.

Refer to *Plate 18, Nos. 9, 10. 1855 Alteration of Model 1841.* Regulation.

July 5, 1855, the following changes in the Model 1841 rifle were ordered: " Percussion Model 1841; the bore of this arm to be reamed up to calibre .58 and re-rifled, and a stud and guide attached for sword bayonet."

The object of the change to the bore and grooving was to use in these rifles the .58 calibre Minié bullet, such as the other service arms were to use. And as this bullet had different ballistical properties from the old spherical one, new sights, not mentioned in the order, also were supplied. And, after 1859, triangular bayonets with sockets instead of sword bayonets were fitted to the bulk of the altered arms.

No. 3, Model 1855 Rifle Musket. Regulation.

The specimen shown is marked " Springfield 1855." This was the first issue of an all new rifle of musket size and with a long, thin barrel. It began the total superseding in the United States of the musket with

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the rifle for all branches of the service, no smooth bores being made after 1856.

The calibre of .58, experimentally tried in converted muskets, was determined upon for all newly made rifle muskets, and became official in 1855, and was continued until the era of U. S. government-made breechloaders.

The charge for this rifle was 60 grains of powder and 500 grains of lead. There were 3 grooves. Ammunition, boring and grooving were the same as for the Model 1855 rifle already described.

The accuracy was sufficient to hit the size of a man on horseback at 600 yards, and the power sufficient to penetrate 4 inches of soft pine at 1,000 yards. At lesser ranges the rifle musket was expected to put 10 consecutive shots in a

4	inch	bullseye	at	100	yards
9	"	"	"	200	"
11	"	"	"	333	"
18½	"	"	"	400	"
27	"	"	"	500	"

In 1859 a patch box was added to this arm.

No. 4, Model 1855 Cadet Size Rifle Musket. Regulation.

The barrel is 2 inches shorter than that of the service arm; the stock is about 1 inch shorter, measuring from the center of the butt plate to the center of the trigger. Bore, grooving and ammunition were the same as for the service rifle musket. All cadet arms were made for issue to the cadets at

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the Military Academy at West Point and the Naval Academy at Annapolis.

No. 5, Greene Oval Bore Rifle. Regulation. Marked " Greene's Patent Nov. 17, 1857." Length about 52½ inches; length of barrel 36 inches; calibre of bore before ovaling .53, depth of cutting each side .008, making the calibre .546; pitch 1 turn in about 50 inches. Weight without bayonet 10 pounds. The charge, in a paper packet, was 2¼ inches long, and contained 68 grains of powder and a Minie bullet weighing an ounce and a quarter.

The wood was filled and coated with linseed oil. The hammer was case-hardened in colors; the ramrod was bright steel; all other metal parts were blued.

The inventor was Lieu't Colonel J. Durrell Greene, U. S. Army. The rifles were made in the Waters shops at Millbury, Mass. The machinery for making the oval bore rifling was purchased of Charles Lancaster, London, England, who for many years had been making oval bore rifles.

The hammer is underneath the barrel and provided with a ring for pulling with the index finger. The barrel loads at the breech, bolt action. With the thumb of the right hand a release-button is first pressed. Then the bolt handle is swung upward and the bolt drawn back and a bullet dropped into the opening; then the bolt is thrust forward and the motion continued by sliding the bolt handle further forward than normal, operating an auxiliary con-

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centric rod which shoves the bullet to the front part of the chamber. The bolt then is again drawn back to clear the chamber and a cartridge-packet having the bullet at the rear is inserted and seated by the next forward movement of the bolt. Turning the bolt handle down to the right locks the bolt by means of two lugs wedging into the standing breech. The rifle is then ready to fire, having two bullets in the chamber, the rear one serving as a gas-check.

When the chamber became foul it was impossible to force the rear bullet forward and the rifle had to be loaded at the muzzle. The bore itself, however, was swept as clean by the passage of each bullet as the inventor of the action claimed it would be, and the bristle brush, contained in the trap in the butt, when wound with a rag moistened with oil, kept the bore in fine order.

Noteworthy features of this ancient bolt action: — the bolt lugs are at the front of the bolt. The bolt cannot drop out when the rifle is held upright and jarred. The opening of the receiver is at the top, where it causes the least trouble from flip, and otherwise than this opening the receiver supports the breech of the barrel symmetrically.

No. 6, Colt Revolving Rifle. Militia.

While the patent for the mechanism was taken out in 1855 there was no issue of these rifles from the factory until 1857, the intervening time being given to experiments to perfect the locking, unlocking and turning of the cylinder.

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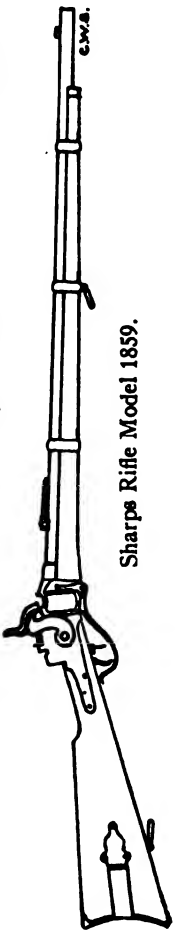
The specimen illustrated is a five-shooter of .56 calibre. Of such arms a good many were purchased for the use of the militia of various states, and many militia companies entered the Civil War armed with them and never having fired them. Besides the 5-shot .56 calibre rifle the Colt Company made a number of sizes in the attempt to adapt them to the various branches of the service. When used in the Civil War the soldiers in all branches of the service disliked them exceedingly on account of the flash and loud report so close to the face and the fearful recoil when several chambers went off at once.



Sharps Rifle Model 1859.

No. 7, Lindner Rifle. Regulation. The patent, issued in 1859, was for a breech loading device for converting muzzle loaders. The specimen shown is a Model 1841 converted by the Lindner method in 1862 by the Amoskeag Mfg. Co., of Manchester, N. H. That this rifle was not at the same time rebored from .54 to .58 is evidence of the pressing need then for arms in the field.

Sharps Rifle Model 1859. Militia. Marked "New Model 1859. C. Sharps patent 1848, 1852." The 1859 model was the first issued

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with a magazine disc-primer lock. (See Sharps Carbine 1859). Length 3 feet 11 inches. Length of barrel 2 feet 5¾ inches. Calibre .52. Six grooves. A knife blade was screwed to the front face of the breech block to cut off the end of the linen cartridge if it failed to go entirely into the chamber. Sharps rifles leaked fire between the breech block and barrel; otherwise they were excellent capping breech-loaders. Their rapidity of fire and their accuracy enabled a soldier marksman to hit his enemy first, and the renown of Civil War companies of infantry armed with Sharps rifles soon gave rise to the laudatory term, "Sharpshooters."

No. 8, Sharps & Hankins Rifle. Regulation. Christian Sharps' patent of 1859. Made at the Sharps & Hankins factory in Philadelphia, Pa. The Sharps factory in Connecticut produced the falling breech rifle and pistol; the Philadelphia factory produced the Sharps & Hankins metallic cartridge rifle, carbine and pistol, in which, by the action of the swinging trigger guard, the barrel slid forward along the metal fore-end projection of the frame. The early specimens used rim fire cartridges and the later ones center fire. Knife bayonet, Dahlgren pattern.

No. 9, Spencer Repeating Rifle. Regulation. Christopher M. Spencer's patent of 1860. Made by the Spencer Repeating Arms Company, Boston, Mass. Calibre .56, rim fire. Extensively used in the Civil War and at that time more widely known

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and more popular than the Henry, which was the principal other repeater of the time. The Spencer Company was purchased and absorbed by the Winchester Company in 1870.

The Spencer rifle was considered by general officers of both line and staff to be the best rifle in use during the Civil War, and during the war about every variety then known of both breech and muzzle loading rifles of flint, cap and cartridge types were given the exhaustive test of hard use. The Spencer was a seven shot rifle loaded through a trap in the butt plate. The loading was a bit slow, with one cartridge at a time, until the appearance of Blakeslee's patent cartridge box containing 10 tin tubes each holding seven cartridges, each tube loadable as a unit. This method was in use during the last two years of the war, although the box was not patented until 1865.

The Spencer rifle originally was without a cut-off device for the magazine. This defect was removed by the ingenious device of Edward M. Stabler, of Maryland, a Quaker who, curiously, was a keen follower of out-of-door sports with rod and gun. While seeking recovery from an attack of tuberculosis by living out-of-doors in the forests of his native state he made over the Spencer rifle that he was using to suit his own individual needs and ideas; and of the changes that he made the cut-off device proved to have general value and was adopted by the Spencer Company for their subsequent improved arms.

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No. 10, Lindsay Two Shot Muzzle Loading Rifle Musket. 1860. Experimental.

Marks, "Lindsay Patent October 9, 1860." Length 56 inches. Length of barrel 41 inches. Calibre .58. Pitch left to right 1 turn in 6 feet. Same boring and grooving as the regular Springfield barrels of the time. Weight without bayonet 9 pounds. Charge, 60 grains of powder and a 500 grain bullet of special design. The cone and the rear sight are blue; all other metal parts polished bright.

This innocent looking weapon has the interesting feature of firing two charges, loaded one on top of the other, from its single barrel. The inventor was J. P. Lindsay, an employee at the Springfield Armory. Five hundred of these rifles were made at the Springfield Armory and issued to troops for trial. Lindsay's belief was that the bullet of the rear charge would act as a base and a gas check for the front charge. The superposed load device was ages old, but the lock mechanism can be credited to Mr. Lindsay, and it was ingenious, simple and good. There are two side-by-side centrally hung hammers, operated by a single trigger. The trigger works perfectly, whether either hammer is cocked or both are at cock at once; in this latter case the right hammer always falls first. The fire from the cone hit by the right hammer runs along a canal to the forward charge of powder. The fire from the left cone communicates directly with the charge at the rear.

According to tradition Mr. Lindsay's brother, a

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soldier, was killed by Indians, who pursued their usual tactics of drawing the fire of a small outpost and then charging in overwhelming numbers, before the soldiers could reload their single shot arms, and massacring the entire company. The Lindsay two-shooter with the appearance of a single-shooter was intended to offer the sort of surprise that would discourage repetition of such tactics.

In spite of the simplicity of this arm it failed to work well. The long canal became blocked with fouling, so that the forward charge was often useless; and occasionally the forward charge, when it did go, leaked past the bullet at its base and fired the rear charge too.

Plate 20

No. 1, Plymouth Rifle, 1861. Regulation.

Issued to the navy. Calibre .69. Peculiarities: — the large calibre, the Dahlgren knife bayonet, the finger grip on the guard bow, the very large ramrod head. Made by Eli Whitney, Whitneyville, Conn.

No. 2, Merrill Rifle. Regulation.

This arm embodies J. H. Merrill's patents of 1858 and 1863 for a device for converting muzzle loaders to breech loaders.

At the Merrill shop in Baltimore, Md., various United States military rifles were converted; the one shown was formerly a Model 1841; in all about fourteen thousand muzzle loaders were made into Merrill breech loaders.

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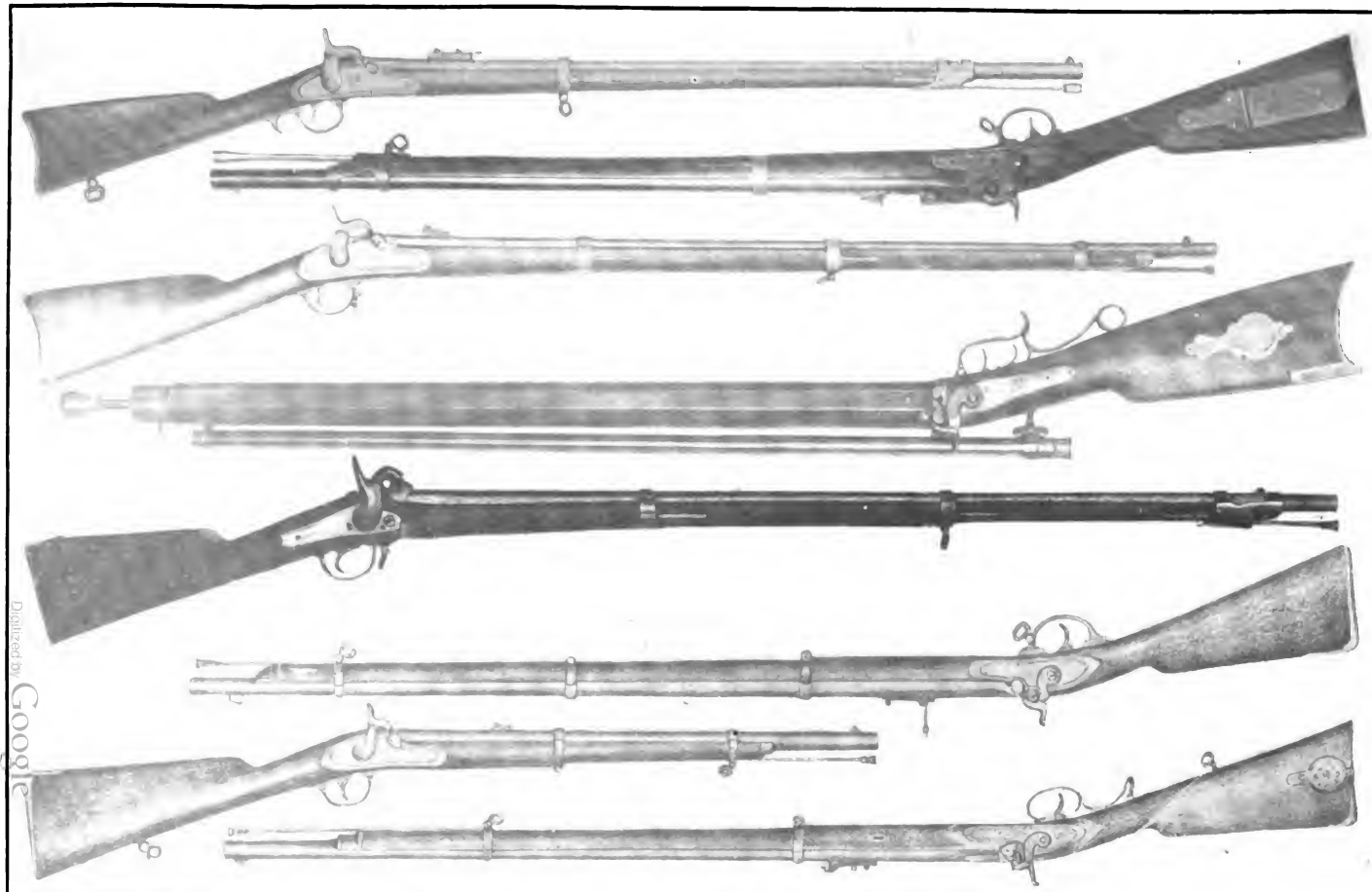

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No. 3, Springfield Model 1861 Rifle Musket. Regulation.

The changes from the Model 1855 consist of the omission of the Maynard priming magazine; a swell on the ramrod near its head to cause it to grip its seat and stay in place; a different rear sight.

Refer to *No. 4 on Plate 21. Model 1861 Rifle Musket, Colt Pattern.* Regulation.

This contractor arm is so nearly an exact forerunner of the Springfield Model 1863 that no difference would be seen in a small picture, hence the picture of the latter serves for both.

No picture. Cadet Size Springfield Model 1861 Rifle Musket. Regulation.

This arm is not illustrated because of its conformity, in all but size, with the picture of the Model 1861 Rifle Musket. Only one model of cadet rifle is shown — the Model 1855 — the others will be merely itemized in their proper sequence.

No. 4, Snipper Rifle, Civil War. Regulation.

This is a typical specimen of the heavy snipper rifles furnished by the United States during the Civil War to expert shots for eliminating the officers of an opposing army. The armies of both belligerents contained many expert marksmen whose special skill it was desirable to use. In the North, while special rifles were being made, agents of the government meantime made a house-to-house canvass, in districts of promise, for the privately owned match rifles which were suited to long range work.

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(For this latter, more elaborate arm, see the Little George Lainhart rifle, in Chapter II.) The accuracy of the best of such arms was of a grade that has never been surpassed at moderate distance; and at long range the best testimonial of their deadly precision was the constant printing, by the newspapers of the period, of lists of casualties due to those rifles.

The specimen illustrated bears no mark of its maker, but both rifle and telescope were made by W. G. Langdon, a Boston watch and clock maker and expert rifleman, who in 1862 contracted to make for the government a score of such rifles at $150.00 apiece, telescope included. After the war this rifle came again into the maker's possession and remained with him until his death in 1896. Mr. Langdon claimed the invention of the means of making this seamless drawn steel tube for the telescope.

The courtesy is acknowledged of Francis R. Bangs, Esq., for the picture of this specimen in his arms collection.

No. 5, Civil War Belgian Rifle Musket. Foreign purchase.

This arm is illustrated merely as an example of one of the many varieties of ancient and unwieldy muzzle loaders that were purchased abroad by agents of both the North and the South, more to prevent the other combatant from getting ready-made arms than for any merit in the arm itself.

All the principal manufacturing countries of Europe as well as Great Britain sold the belligerents

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as many as possible. The North got, and used, nearly all it bought; the South was unable to transport more than a small part of its purchases.

No. 6, Civil War Enfield Rifle, Long Pattern. Foreign purchase.

This weapon occupies a rather important place among our military arms because of the enormous number used in our Civil War. The United States bought over four hundred and twenty-eight thousand for Civil War use. The Confederacy bought Enfields, also, but was unable to use them as extensively as did the armies of the North.

Some of these rifles were made at the Enfield works and were marked with "Tower, V R" and a crown; some were made by contractors for Great Britain and others by contractors for the United States.

The weight was 8 pounds, 14½ ounces; length about 54 inches; length of barrel about 3 feet 3 inches; diameter of bore .577; number of grooves 3; pitch of grooves 1 turn in 6 feet 6 inches; diameter of Pritchett bullet .568; weight of bullet 530 grains; charge of powder 2½ drams (about 70 grains).

From these arms our Ordnance board adopted the form of the ramrod head. On the other hand the British War Office had, apparently, adopted for them the kind of rifling of our 1855 model rifles, that is, three broad grooves of progressive depth, from .005 at the muzzle to .015 at the breech, so that the

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Enfields, of .577 calibre, used without trouble our .58 calibre ammunition.

With its own service charge the Enfield, fired at 500 yards, had a mean deviation of only 2¼ feet; with our service charge nearly the same amount of accuracy was maintained. Undoubtedly Enfields were the best of our purchased arms, and did us excellent service.

No. 7, Civil War Enfield Rifle, Short Pattern. Foreign purchase.

Great Britain first issued this pattern in 1858. Although originally intended for navy use it was soon issued to rifle regiments and to sergeants of infantry. Our government bought them to issue to Artillery, Engineers, and the navy, and to non-commissioned officers of infantry.

The weight averaged about 8½ pounds; most of them were equipped with the sword pattern bayonet. The barrel length was about 2 feet 5 inches; the bore was .577, the number of grooves was 5, and the pitch was progressive, giving 1 turn in 4 feet at the muzzle. Accuracy was slightly better than that of the long pattern.

No. 8, Civil War Enfield Rifle, Long Pattern, Officers' Model. Foreign Purchase.

PLATE 21

No. 1, Peabody Rifle. Experimental.

Henry O. Peabody's patent of 1862. The conversion of a Springfield muzzle loader to a breech loader by the Peabody system.

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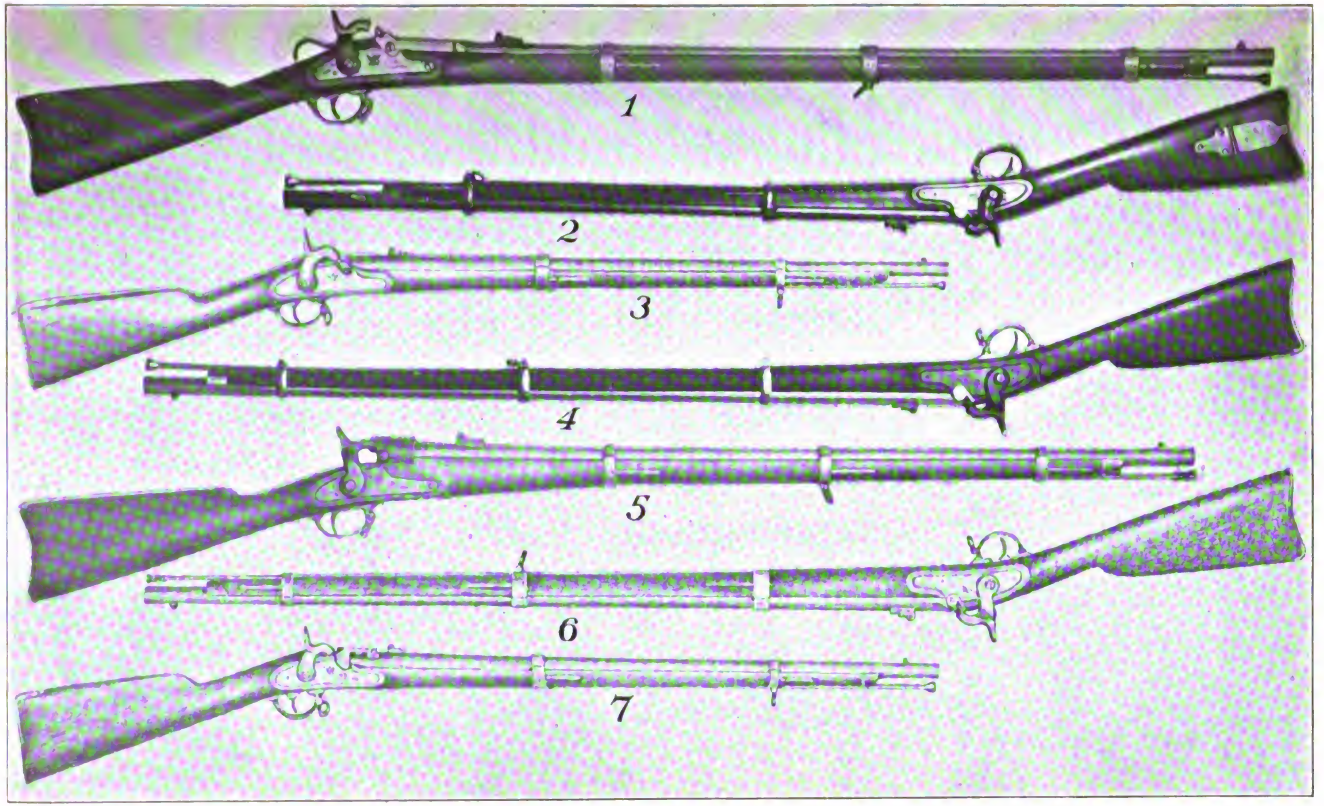

PLATE 21

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No. 2, Remington 1863 Rifle. Regulation.

Marks: " Remington's, Ilion, N. Y., 1863," and an eagle. Length without bayonet 4 feet 1 inch. Length of barrel 2 feet 9 inches. Calibre .58. Seven narrow, shallow, segmental grooves having a pitch of 1 turn in 5 feet. Weight without bayonet 9 pounds 6 ounces. The charge was the service one of 60 grains of powder with a 500-grain hollow base bullet, but after the war, when the rifle got into civilian hands, a powder charge of 75 grains was preferred. The bayonet was modeled after the 1855 sabre bayonet, but was straighter, 2 inches shorter and a half pound lighter.

This admirably made and extra good military rifle was of more pleasing appearance than common. The wood, black walnut as usual, was filled, linseed oil coated, allowed to dry, and then rubbed to a polish. The lock plate and the hammer were case-hardened in quiet, mottled colors. The barrel was finished blue-black, whether by heat and oil or by chemicals is now unknown; the trigger, band springs, and all screws were polished and heat-blued. The blade of the bayonet and the sling swivels and the ramrod were of polished steel. The rest of the furniture was of brass polished to brilliancy. Standardization of sizes and shapes, giving interchangeability of parts, was carried to a perfection not since surpassed; and the workmanship within was as good as that on the outside.

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No. 3, Springfield Model 1863 Artillery Rifle Musket. Regulation.

Calibre .58. Weight about 8 pounds. Length of barrel about 33 inches. Two bands. Except for adherence to these specifications the details of this class of arms did not follow a prescribed rule.

These arms were made during 1863, '64 and '65 from the left-overs of rifles and muskets of 1865 and preceding years. The specimen shown has a lock of the 1861 pattern bearing the date of 1862; a cut-down barrel dated 1863; a re-shaped Model 1841 stock, and a butt plate of 1819 pattern. Some of the specimens of this arm, now in collections, are mounted with brass and others with iron, and still others with part each. These arms were made during that part of the Civil War when adherence to a standard pattern became a detail of minor importance, because the main object was to get something — anything — that would shoot.

The issue of these arms was to artillerists — field and coast — for personal defense under unusual conditions, and for use when foraging as mounted infantry.

No. 4, Springfield Model 1863 Rifle Musket. Regulation.

Changes from Model 1861: — the end of the muzzle is slightly countersunk to prevent damage from bruises; cone seat improved; hammer of revised form; lock plate-casehardened in colors; band springs omitted, and bands of different form held

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in place by the grip afforded by adjustment screws; swell omitted from ramrod; improved rear sight; bands, swivels and trigger heat blued on some and on others the blued pieces were the cone, screws and sights.

The specimen shown is marked "Springfield 1863." Its length is 56 inches; length of barrel 40 inches; calibre, grooves and pitch unchanged. Weight without bayonet 8 pounds 10 ounces.

In this model the general features of the Model 1861 Colt pattern were followed.

No. 5, Joslyn Rifle, 1864, Militia.

B. F. Joslyn's patent device converting a muzzle to a breech loader.

No picture. Mixed Models of Rifle Muskets of the Civil War Period. Regulation.

During the Civil War when exigencies demanded more arms than could be issued of the model then under manufacture, spare parts of preceding models were drawn from the storehouses and incorporated with parts of the latest design. Not only was this done in the shops of the government but also some of the contractors were furnished with extra parts made in the government shops.

No. 6, Springfield Model 1864 Rifle Musket. Regulation.

Ending the era of the military muzzle loader.

Changes from the Model 1863 consisted of — a reversion to band springs and flat bands; change in

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the shape of the head of the ramrod; change in the means of securing the rear swivel; improved type of rear sight. Otherwise like the Model 1863.

After the battle of Gettysburg, fought July 1 to 3, 1863, there were gathered from the battlefield something like twenty thousand guns, muzzle loaders mostly, the majority of which were loaded with from two to ten charges rammed one on top of the other by soldiers too excited or too ignorant of arms to know enough to fire each charge after loading. Allowing that as many more such useless arms were taken away by their owners and not thrown away, military statisticians figured that about 35 per cent of all the forces engaged on both sides might as well have carried pikes. Also they realized that only half the fault lay with the soldiers; the other half was due to the fact that the weapon gave no evidence of whether it was loaded or empty. It was evident, too, that a breech loading system of the right type would cause the soldier to fire before reloading was possible; and the subject of muzzle versus breech loading was for the first time taken seriously by the War Department.

To make the change from the manufacture of muzzle loading to breech loading arms during the continuance of the war was of course inexpedient, hence the Model 1864 rifle musket was, like previous models, a muzzle loader; but it was the last one and it marked the end of the old era in our military small arms.

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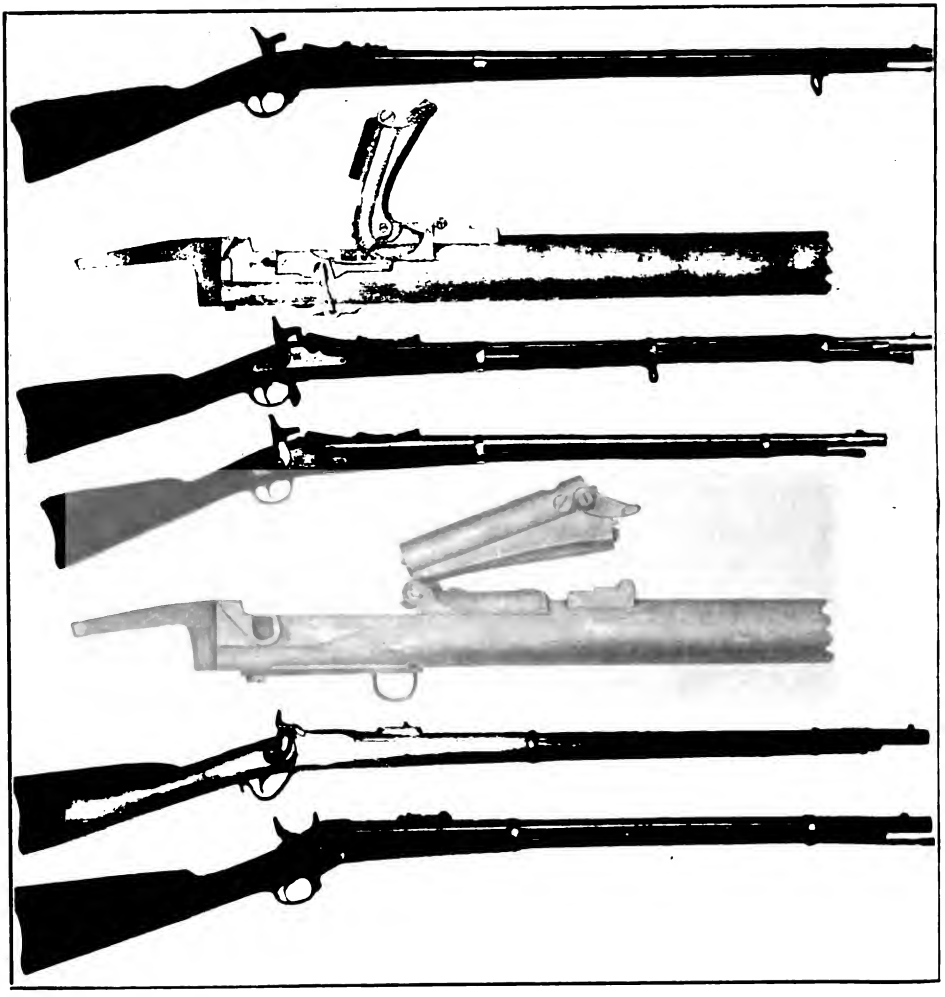

PLATE 22

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No. 7, Miller Rifle. Militia.

A device for the conversion of muzzle loaders employed during 1865.

PLATE 22

No. 1, Model 1865, Springfield Conversion. Regulation.

Beginning the era of the metallic cartridge military breech loader.

Shortly after the close of the Civil War in April, 1865, a Board was appointed to select a breech loading system for the army. The enormous stock of muzzle loading arms on hand was too valuable to be discarded immediately, so the government invited inventors to submit to the Board designs for converting them. Of the many methods submitted the one chosen was by the Master Armorer of the Springfield Armory, Mr. Erskine S. Allin. His proposition was to retain unchanged all the parts of the old arms except the rear of the barrel, in place of which he provided a mechanism to be screwed on. Incidentally a little cutting of the wood underneath and beside the barrel was found to be necessary to accommodate some of the projecting parts.

Five hundred muzzle loaders were altered immediately by the Allin system to take .58 calibre rim fire cartridges, and issued to soldiers for trial in the field. The specimen shown has the date "1865" stamped on the lock plate, together with "Springfield" and the usual eagle.

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No. 2, Mechanism of the Model 1865.

The cartridge being short, the receiver also is short, and its length is indicated in the picture by the length of the breech plug. The breech block is shown thrown forward to the limit. The extracting mechanism, which slides in a slot cut lengthwise entirely through the right side of the chamber, consists of a sliding rack with teeth on it and a spring to throw it forward when its teeth disengage from the teeth in the curved part of the front end of the breech block. The firing pin and the latch of the breech block are not provided with springs; both rattle loosely. The extracting mechanism is frail and complicated, and balks easily; the latch mechanism has more bad points than good. The mechanism as a whole is so immature that it is positively bad. Many radically better conversion systems than the Allin were offered to the Board of '65 and no reason for the selection of the Allin can now be perceived. However the officers of the Ordnance Department had to accept it because it was thrust upon them; and after eight years of experiments and changes it became a good mechanism; but by that time there was left of it very little of the Allin System.

No. 3, Model 1866. Regulation.

During the latter part of 1865 and during 1866 five thousand muzzle loaders were altered to the Allin System according to a new plan. In this " the extractor consists of a U-shaped spring against

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side of the receiver. One part of the spring projects into the side of the receiver and catches the rim of the cartridge as the cartridge enters the chamber. Closing the breech block compresses the spring, which is released on opening with sufficient strength to eject the empty shell."

The specimen shown is dated 1866 on the new breech piece. With this model the calibre was reduced to .50 by brazing a lining tube in the barrel. The cartridge was center fire; the copper shell had the primer hidden inside the center of the head; the shells were not reloadable. The charge was 70 grains of powder and a 450-grain elongated bullet. The muzzle velocity was about 1,240 f. s.

No. 4, Cadet Size Model 1866. Regulation.

No. 5, Mechanism of the Model 1866.

No. 6, Peabody Rifle. Militia.

This was Henry O. Peabody's patent of 1866, and was a better one than that of 1862. It was made in great quantities by the Providence Tool Co.

No. 7, Remington-Rider Rifle. Regulation.

The first use of this arm was in 1867, when the government ordered a quantity for the navy. The patent had been issued to Joseph Rider in 1864. Mr. Rider was soon after employed by the Remington Company, and developed the design in their shops at Ilion, N. Y.

This breech action was strong, thoroughly effective,

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yet extremely simple. It quickly became world-popular for military arms, and lasted until displaced by the repeater. Arms of this type, in America, were made in all usual military patterns as to length weight, disposition of bands, etc.; and the action itself went through many modifications as regards extraction and ejection, safety lock, half cock stop, etc., etc.

The picture serves for both Remington and Whitney make of Rider arms.

Plate 23

No. 1, Snider Rifle. Foreign purchase.

The breech action of this arm, at first designed merely as a conversion, was the invention, about 1860, of Jacob Snider, an American. It was offered to our government, and refused. It was then offered to Great Britain, and accepted, and used at first for converting Enfield muzzle loaders of the 1858 pattern. The action was good but for the first few years the cartridge was poor; with the development of the Boxer cartridge shell Snider rifles took high rank. It is now uncertain whether the Snider rifles that were purchased of Great Britain were used in the final year of the Civil War or whether they were, later, issued to militia.

No. 2, Roberts Rifle, 1867. Experimental.

The conversion device was the invention of General B. S. Roberts, U. S. A. Not known to have been much in use.

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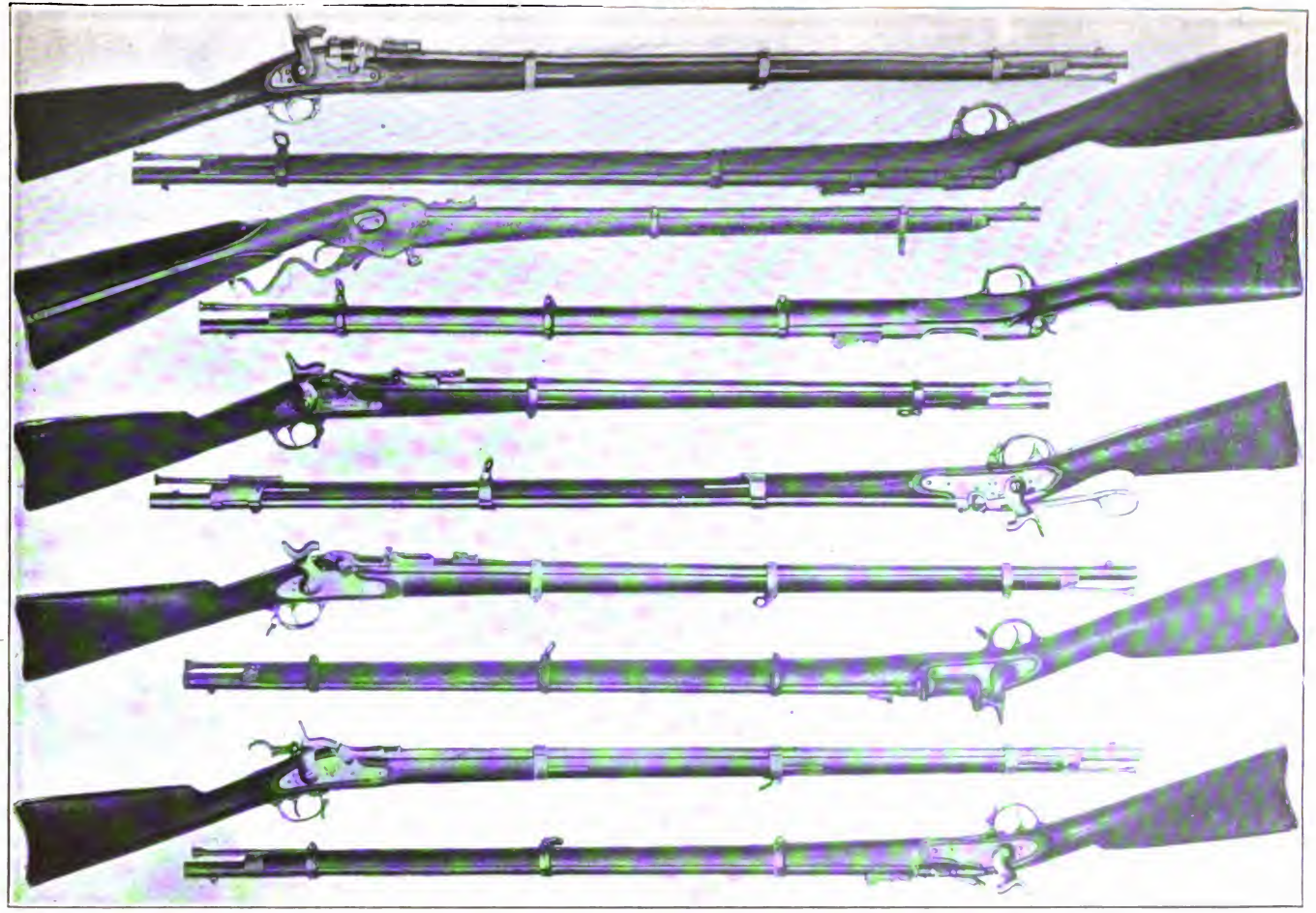

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No. 3, Needham Rifle. Regulation and militia.

In this conversion device the breech block swings horizontally to the right, and forward. Its common-use name always has been Bridesburg Rifle, because nearly all these conversions were made in the shops of Alfred Jenks & Son, proprietors of the Bridesburg Machine Works, whose mark, stamped on the rifles, was "Bridesburg." The period was before and after 1867.

No. 4, Lamson Rifle. Experimental.

This conversion device, a modification of the Allin System, is believed to date about 1867.

No. 5, Unrecognized. Experimental?

While it is possible that this arm is a "Fusil Robert," advocated in 1837 for United States adoption by Baron Hackett, it appears more probable that it was submitted about this period to an Ordnance Board by Westley Richards, whose "Monkey Tail" action it strongly resembles.

No. 6, Springfield Model 1868. Regulation.

The policy of converting muzzle loaders was now in part abandoned and some entirely new barrels were made. There were no radical changes in the appearance of the new gun, but there were many minor improvements. The length of the new arm, stamped "Model 1868," was reduced to about 4 feet 4 inches, and its weight to 9¼ pounds. The extracting device was considerably strengthened and simplified, and the latch was made more secure. The ammunition remained the same.

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No picture. Cadet Size Model 1868. Regulation. In all but size and weight similar to the service rifle.

No picture. Springfield Model 1870. Regulation. Slight changes in barrel, breech block, and rear sight. Ammunition unchanged. Its picture would resemble that of Model 1868.

No. 7, Brown Rifle. Militia.

Made by the Brown Mfg. Co., Newburyport, Mass., 1871. J. H. Brown invented also the wire-wound gun (cannon).

No. 8, Evans Rifle 1871. Militia.

This 1871 pattern of Evans military rifle differs in forms of frame and moving parts from the sporting patterns of a few years later. Refer to Evans Sporting Rifle, Chapter III, and Plate 16.

No. 9, Ward-Burton Rifle 1872. Experimental. Several hundred were made at the Springfield Armory and issued to troops for trial in the field.

No. 10, Phoenix Rifle 1872. Experimental.

This form of conversion was made and advocated by Eli Whitney. The action shown is the original of the later and better action extensively used on Phoenix sporting rifles.

No picture. Sharps Rifle, 1872. Militia.

The 1872 Sharps was the same in action as the 1874 sporting pattern (see Plate 15, No. 2), and differed from preceding Sharps in being adapted to metallic cartridges.

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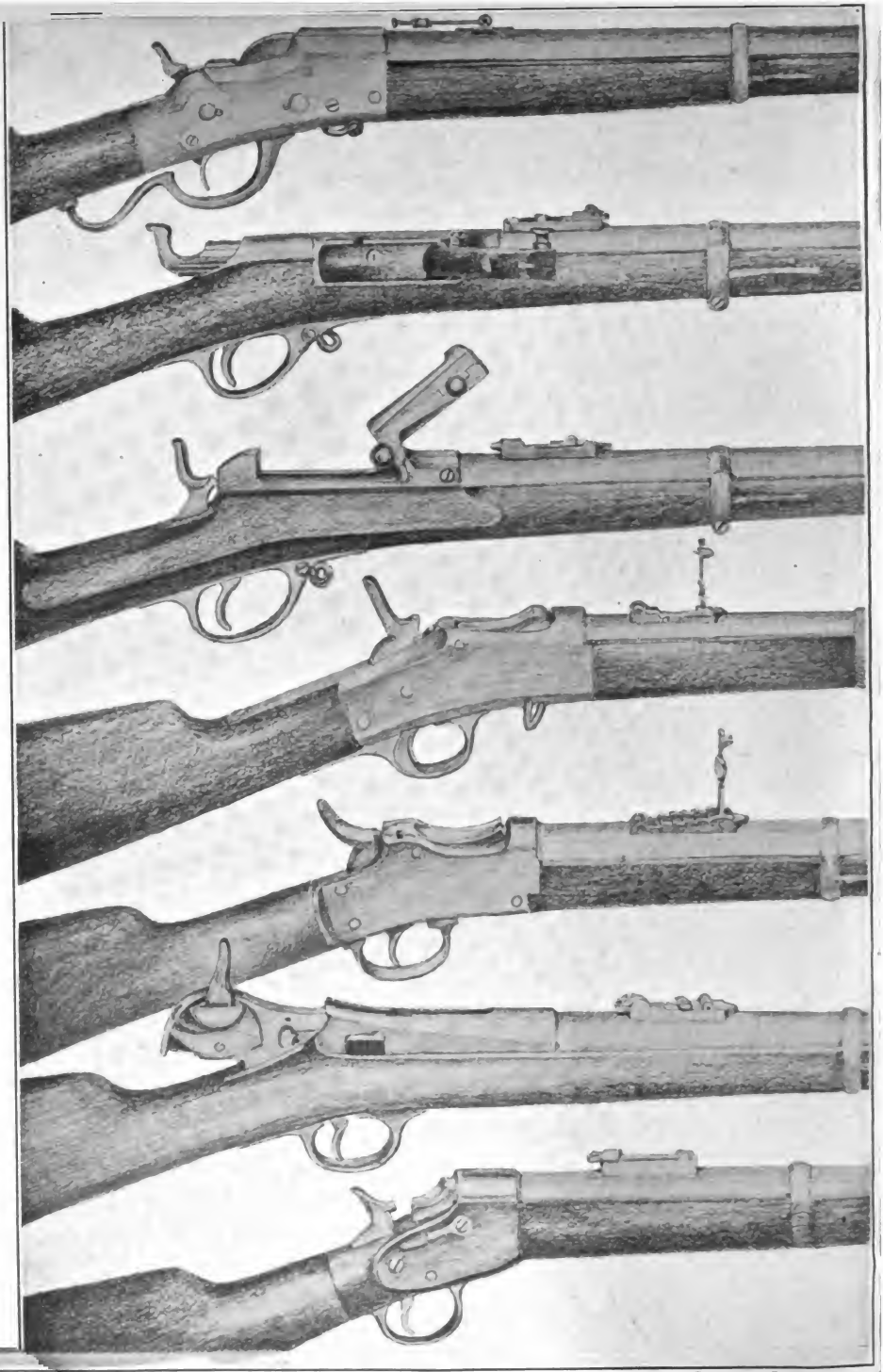

PLATE 24

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American Inventions of Breech Actions for Single Shot Metallic Cartridge Rifles Submitted to and Refused by the United States Ordnance Board of 1872.

The Springfield-Allin System used in United States military arms having been designed for the purpose of converting muzzle loading arms to breech loaders, Congress in June of 1872 enacted that a breech loading system for army and navy be adopted upon the recommendation of a Board of Officers to be appointed by the Secretary of War. This was in the hope of getting a system better than the Allin.

To the Board 99 American and 9 foreign designs were submitted. Some of them were merely wooden models; some were variants, great or small, on systems already in use. The designs shown by the illustrations, taken from U. S. "Ordnance Memoranda No. 15," are the ones of most ingenuity, oddity, or general interest. All of them both extract and eject.

Plate 24

No. 1, By John Broughton. To open: by throwing forward the guard lever, which is pivoted on the rear corner of the breech block, the locking device is released, the breech block is swung downward and backward, the lock is half cocked, and the extractor is operated.

No. 2, By John Broughton. To open, draw back the firing bolt until it cocks, press down the

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thumb piece and swing the breech block sideways and forward until it is nearly parallel to the barrel.

No. 3, By John Broughton. To open, cock; press forward the lever-catch, which slides the firing pin forward and disengages its rear end from the cavity in the receiver; swing the breech block upward and forward. Odd and interesting feature: — on closing, not only does the firing pin lock the bolt but also the nose of the hammer when down.

No. 4, By W. H. Elliot. To open, cock; the hammer operates a lever on the breech block pawl and alternately pushes and pulls against the lower arm of the breech block and opens and closes the breech. After opening, the hammer falls forward; to close, the hammer must again be cocked. The hammer cannot be let down slowly. The guard is hinged at the rear to permit inspecting and cleaning the mechanism.

No. 5, By James Lee. To open, shove forward the thumb piece of the hammer, which depresses the breech block. To close, insert a cartridge; its rim, moving back the extractor, permits the mainspring to act on the breech block and press it against the cam-shaped hinge pin; when the extractor is fully in its seat the spring throws up the block. The mainspring has two leaves, one of which operates the hammer and the other the breech block.

No. 6, By James Lee. To open, draw back the lever, which is also the thumb piece of the hammer;

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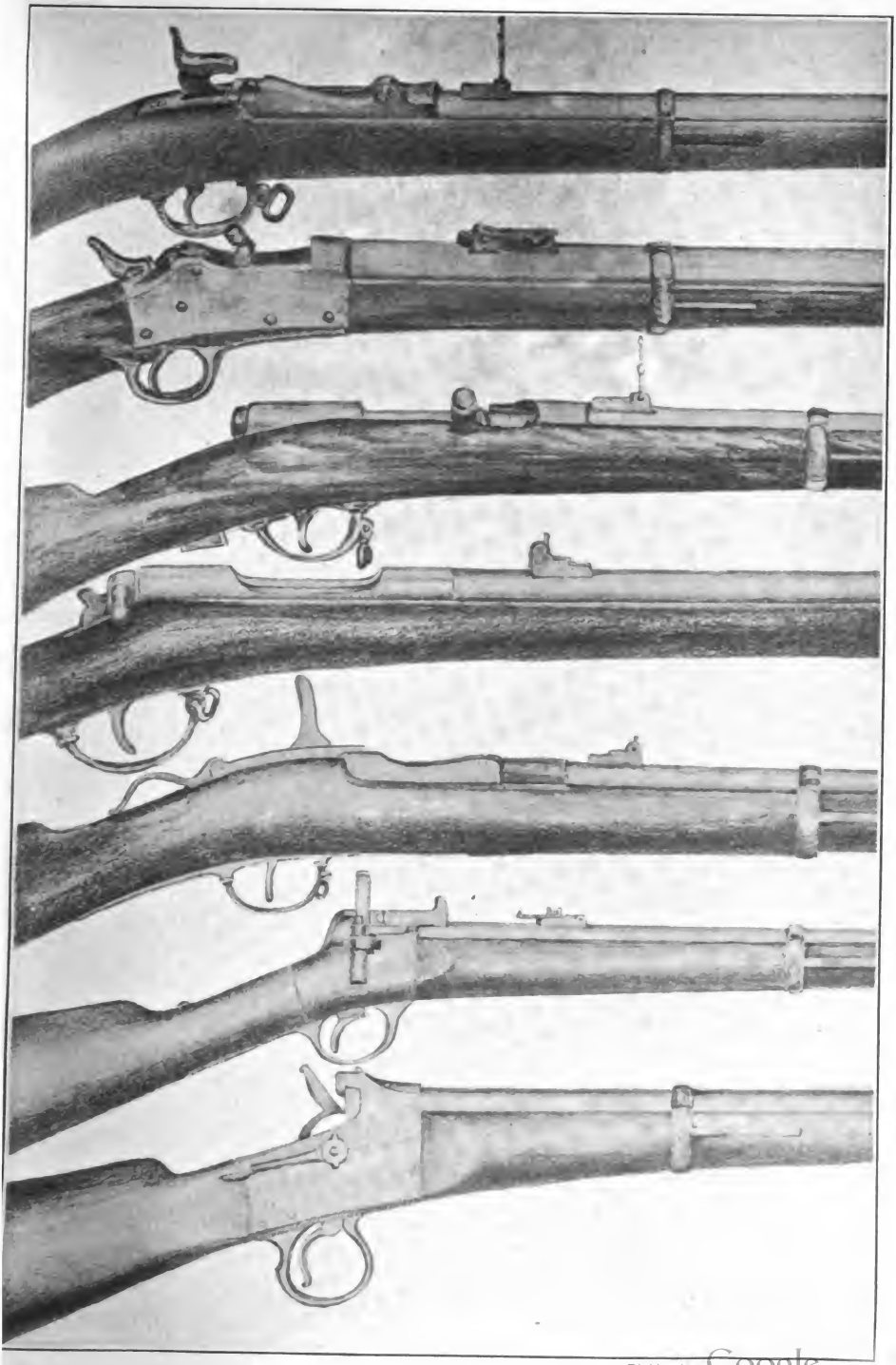

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PLATE 25

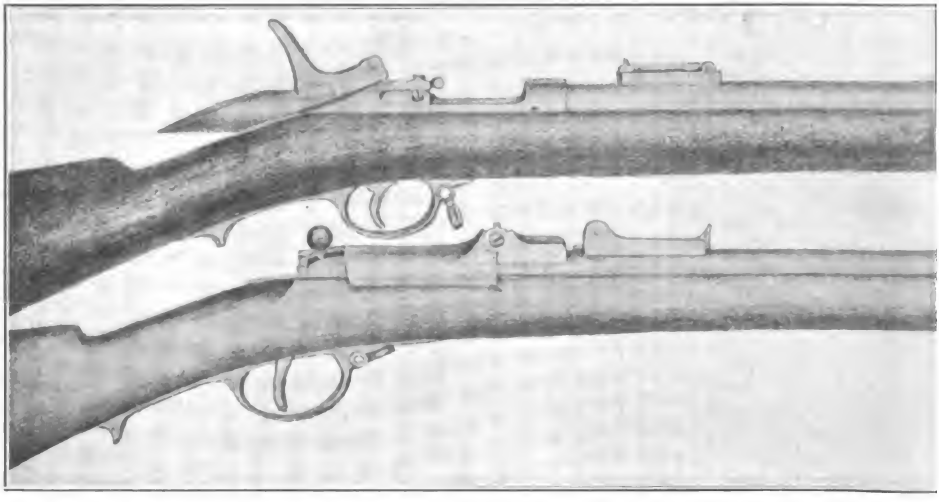

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PLATE 25—Continued

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the pressure of its cam-shaped lower surface on the bottom of the receiver raises the rear end of the breech bolt so that it can be drawn back.

No. 7, By Dexter. To open, half or full cock the hammer; then swing down the lever on the right side of the frame, which depresses the breech block. (In principle generally similar to the Remington-Hepburn action.)

Plate 25

No. 1, By E. S. Allin. The principal difference between this and the regular Springfield-Allin is the center hung hammer, the mainspring of which lies under the receiver. A similar device, which, however, preserved the Allin breech block intact, was submitted by James Stillman, master stocker of the Springfield Armory.

No. 2, W. S. Smoot. To open, cock, then draw back thumb piece of cam-lever, which lowers the breech block. To load and close, insert a cartridge and strike the thumb piece forward with the palm of the hand. The breech block when closed is locked by a projection on the nose of the hammer passing under the rear end of the cam-lever.

No. 3, By I. M. Milbank. To open, raise and draw back the handle of the breech bolt. Individualities: this bolt action is cocked by pressing the bolt forward; ejection is accomplished by a spiral spring set in the face of the bolt; a safety lock pro-

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jecting through the guard strap in rear of the trigger guard must be pressed upward before the gun can be fired.

No. 4, By Ira Merrill. To open, raise and draw back the handle of the breech bolt; this retracts the firing pin, cocks the hammer, and exposes the chamber. Individualities: a center hung hammer apart from the bolt (see also the Remington-Keene repeating rifle, page 182, for a similar device), and a movable ring surrounding the rear of the chamber, which rotates with the bolt, so that, in locking, the bolt face will not grind the head of the cartridge. A rifle submitted by S. F. Van Choate also had a bolt action with a separate hammer.

No. 5, By General B. S. Roberts. To open, raise the lever; this moves rearward and depresses the forward end of the breech block and exposes the chamber. To close, either depress the lever or cock the hammer.

No. 6, By Oscar Snell. To open, cock the hammer by swinging its upright thumb piece downward to the right. As the hammer moves at right angles to the bore, when it is cocked the chamber is exposed and can be loaded from the rear of the frame. When the hammer is down it is bedded in a groove of the frame. The sliding extractor on top of the frame is moved by hand.

No. 7, By William Montstorm. To open, throw down the lever on the right side of the frame; the

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beginning of this movement lowers the breech block and the continuance of the movement rotates the block rearward and cocks the hammer.

No. 8, By B. F. Joslyn. To open, cock the hammer; in so doing the bolt is released, and, with the hammer and lock contained in it, is free to move back. The firing pin being linked to the hammer is withdrawn from the face of the bolt by the act of cocking.

No. 9, By William Morgenstern. To open, draw back the firing pin by its handle until the spiral mainspring is cocked. The breech block may then be thrown forward and upward until it strikes the receiver, in which position it is supported by a catch. An interesting individuality is a rotating extractor which by accelerated motion ejects an empty shell violently upward.

Among the 108 arms submitted to the Board of 1872 there were 10 magazine rifles, one of which, the Helm, was a revolving one, having as its only peculiar feature a movable butt plate which cocked the gun by pressure against the shoulder. The other 9 were: Winchester, forerunner of the Winchester Model 1873; Scott (see Triplett & Scott carbine of 1864); Ball (see Ball carbine of 1863); Stetson, which was a modification of the Winchester; Burgess (see Whitney-Burgess sporting rifle, page 124); Rumsey, which was in the wooden model stage and not easy to understand; Ward-Burton, with magazine below the barrel; Gardner, having a fixed

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chamber closed by a sliding barrel and magazine below the barrel; and an Evans (see Evans sporting rifle, page 124).

With the idea of adding a bit more speed to the fire of the Springfield service rifle several inventors submitted designs for grouping a number of cartridges close to the chamber of the rifle. Colonel J. G. Benton offered two designs; one was to put 5 cartridges in holes in a thickening of the stock at the left of the receiver, the cartridges to be in a row parallel to the barrel, with heads up, and the other was a bundle of 6 cartridges in a detachable block hung against the lock plate. Mr. R. T. Hare's device was a cartridge box with a finger strap across the back so that the fingers of the left hand could grip it against the barrel while the gun was held at aim. Lieutenant Henry Metcalf offered a wooden container of 10 cartridges attachable by wire loops to studs set in the fore stock. General P. V. Hagner showed how 3 cartridges with heads to the rear could be held in a block under the breech. Mr. Ira Merrill showed a gun with the comb cut so as to hold 4 or 5 cartridges upright, covered, all except the front one, and fed forward by a spring. Mr. James Stillman offered a means similar to Mr. Merrill's, except that a swinging lid uncovered all the cartridges at once. The Board examined also a new type of cartridge box to be worn against the left breast; it was circular and about 1½ inches thick; 24 cartridges were set radially, staggered, and with their heads outward; they could be drawn

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out one by one through a notch in the periphery of the box.

After examination and trial of the arms and accoutrements submitted, and a contemporary exhaustive test of ammunition, the decision of the U. S. government was in favor of the service rifle then in use subject to slight modifications, and to a change in the weight of the bullet. The Model 1870, revised to meet these requirements, was named Springfield No. 99, or Model 1873.

American Inventions of Magazine Rifles Submitted to the Board of 1878

Name of rifle	Manufactured by
Franklin	Colt Pat. Firearms Co.
Ward-Burton *v*	Springfield Armory
Sharps-Vetterli *v*	Sharps Rifle Co.
Hunt	C. B. Hunt.
Lewis-Rice	Lewis, Rice & Lewis
Buffington	Major Buffington, U. S. A.
Hotchkiss *v*	Winchester Repeating Arms Co.
Winchester Model, 1873 *v*	Winchester Repeating Arms Co.
Springfield-Miller	W. H. Miller
Remington-Keene *v*	E. Remington & Sons
Tiesing	Whitney Arms Co.
Whitney-Burgess *v*	Whitney Arms Co.
Springfield-Clemmons	G. F. Clemmons
Lee *v*	James Paris Lee
Chaffee	R. S. Chaffee & J. N. Reece

In many cases several guns of the same patent, or inventor, were submitted, totaling 29. From the lot the Board selected one, the Hotchkiss, and recommended that the twenty thousand dollars appropriated for making and trying a magazine

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gun for the military service be expended upon it. Of the remaining twenty-eight, those marked *v* were afterwards manufactured for general sale, all but two of them, the Winchester Model 1873 and the Lee, having a small sale and being soon discontinued. Those not marked *v* or otherwise mentioned were model guns and never were offered commercially. The inventors of some of the model guns still had faith in them and continued experimental work on them; those guns, with revisions and improvements, were, four years later, submitted to another board.

Meantime, the Ordnance Department continued the manufacture and issue of the Springfield .45, single shot, making a change for the better at the very time the Board of '78 was considering an entire change of armament.

Plate 26

No. 1, Model 1873, also called Springfield No. 99. Regulation.

The calibre was reduced to .45, and the ammunition became 45–70–405. The shell was center fire and reloadable. Muzzle velocity was about 1350 f.s. The barrel was made of steel instead of iron, as formerly. There were 3 grooves, equal in width to the lands, .005 deep at the muzzle and progressing regularly in depth to .01 at the breech; the twist was uniform, 1 turn in 22 inches.

The shape of the ejector stud was modified, and a lining introduced into the receiver with the expecta-

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PLATE 26

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tion of facilitating the introduction of ammunition. Cannelures were cut in the small end of the ramrod to permit a better grip with the fingers. A stacking swivel was added, and the swivel of the guard bow was fastened with a screw instead of a rivet. The lock plate was made thinner and without a bevel around its outer edge. The hammer, and all screw heads, and that part of the stock around the lock plate, were rounded. The rear sight, changed to meet the new ballistics of the arm, was set further forward. All metal parts were finished in a dark color. The weight of the rifle was reduced to 8¼ pounds.

Three new types of bayonets, offered the Board of 1872, were issued with this rifle for trial. One was the Rice-Chillingworth, in which the shape of the trowel blade was the design of Lieutenant E. Rice and the combination of socket and handle was by Mr. F. Chillingworth. The second, proposed by Colonel Clitz, a member of the Board, was more of a spade than a bayonet, and when used as the latter would give better results when used as a cutting weapon, striking sideways, than as a thrusting weapon. The third was the sword bayonet already in use modified with saw teeth cut along its upper edge. The two former of course were intended as entrenching tools, and the latter for the use of sappers and miners. The greater part of the Model 1873 rifles issued were, however, provided with a ramrod-bayonet, some triangular and some round in cross section.

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No picture. Cadet Size Model 1873. Regulation.

The changes in the cadet rifle followed those in the service arm.

No. 2, Phoenix Rifle 1874. Militia.

In this arm the action, based on that of 1872, is more fully developed.

No. 3, Lee Single Shot 1875. Experimental.

No. 4, Sharps-Borchardt 1876. Militia.

No. 5, Remington-Keene Repeater 1877. Militia.

No. 6, Springfield Model 1878. Regulation.

The pronounced feature of all the Model 1878 arms is the 3-click tumbler. Its use was continued in subsequent models. Used in the War with Spain.

No. 7, Springfield Universal Model 1878. Regulation.

With this arm the attempt was made to meet the requirements of all branches of the service with a single kind of gun. Length and weight were reduced. The triangular wiping rod served for a bayonet. The front swivel served both for a sling and for stacking. Used in the War with Spain.

No picture. Cadet Size Model 1878. Regulation.

A slightly reduced fac-simile of the Model 1878 service arm.

No. 8, Officers' Model 1878. Regulation.

Detachable pistol grip, checkering, simple engraving, half-stock with white-metal tip, peep and

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globe sights, stout wooden cleaning rod. Used service ammunition.

No picture. E. W. Potter Magazine Rifle, Calibre .45, 1878. Experimental.

No. 9, Lee Straight Pull Rifle. Regulation.

Calibre .236 (6 millimeters). Called also the Remington-Lee. James Paris Lee's patent of 1879. Adopted for the U. S. Navy. Used in our War with Spain. Operating the action by a straight pull of the bolt to the rear was the most interesting feature of this rifle, except, perhaps, its small calibre.

See Plate 14, No. 8. Buck Rifle. Experimental.

Single shot, calibre .45, using service ammunition. Made by H. A. Buck & Co., West Stafford, Conn. Submitted to the government and refused.

Throwing the trigger guard forward opens the breech, cocks, and ejects.

American Inventions of Magazine Rifles Submitted to the Board of 1882

Congress having once more had its attention called to the inadequacy of the single shot rifles with which our troops were equipped, appropriated fifty thousand dollars for magazine arms to be made and issued for trial, and the Ordnance Department thereupon convened a session of officers, called the Board of 1882. Forty guns were submitted to this board, by thirteen inventors, in almost every case there being several guns of a kind, more or less, generally less, modified in the hope that in one form

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or the other a mechanism would successfully pass inspection and trial.

NAME OF GUN	SUBMITTED BY
Remington-Keene *v*	E. Remington & Sons, Ilion, N. Y.
Boch	Philip Boch, N. Y. City
Hotchkiss	Winchester Repeating Arms Co., New Haven, Conn.
Chaffee-Reece	Gen'l J. N. Reece, Springfield, Ill.
Lee	James Paris Lee
Trabue	Wm. Trabue, Louisville, Kentucky
Russell	Lieut. A. H. Russell, Fort Union, New Mexico
Marlin *v*	Marlin Firearms Co., New Haven, Conn.
Dean	Chas. J. Dean, Ft. Walla Walla, Washington
Spencer-Lee	J. W. Frazier, N. Y. City.
Burton	W. G. Burton, Brooklyn, N. Y.
Springfield-Jones	J. Sheridan Jones, Menno, Dakota
Eliot	H. Eliot

The Board recommended the expenditure of the appropriation upon the Hotchkiss, Chaffee-Reece, and Lee rifles. Besides these three the two checked *v* were manufactured in considerable numbers, privately, in the expectation of sale to militia, or abroad. The remaining eight probably never got beyond the model stage.

The Hotchkiss, Chaffee-Reece, and Lee rifles, when issued for trial, did not fulfil the hopes of the Ordnance Board, and the Springfield .45 single shot continued, for ten years longer, to be the regulation military arm of our government.

PLATE 27

No. 1, Hotchkiss Rifle 1882 Pattern. Regulation.

Described under Winchester-Hotchkiss 1883 Sporting Rifle.

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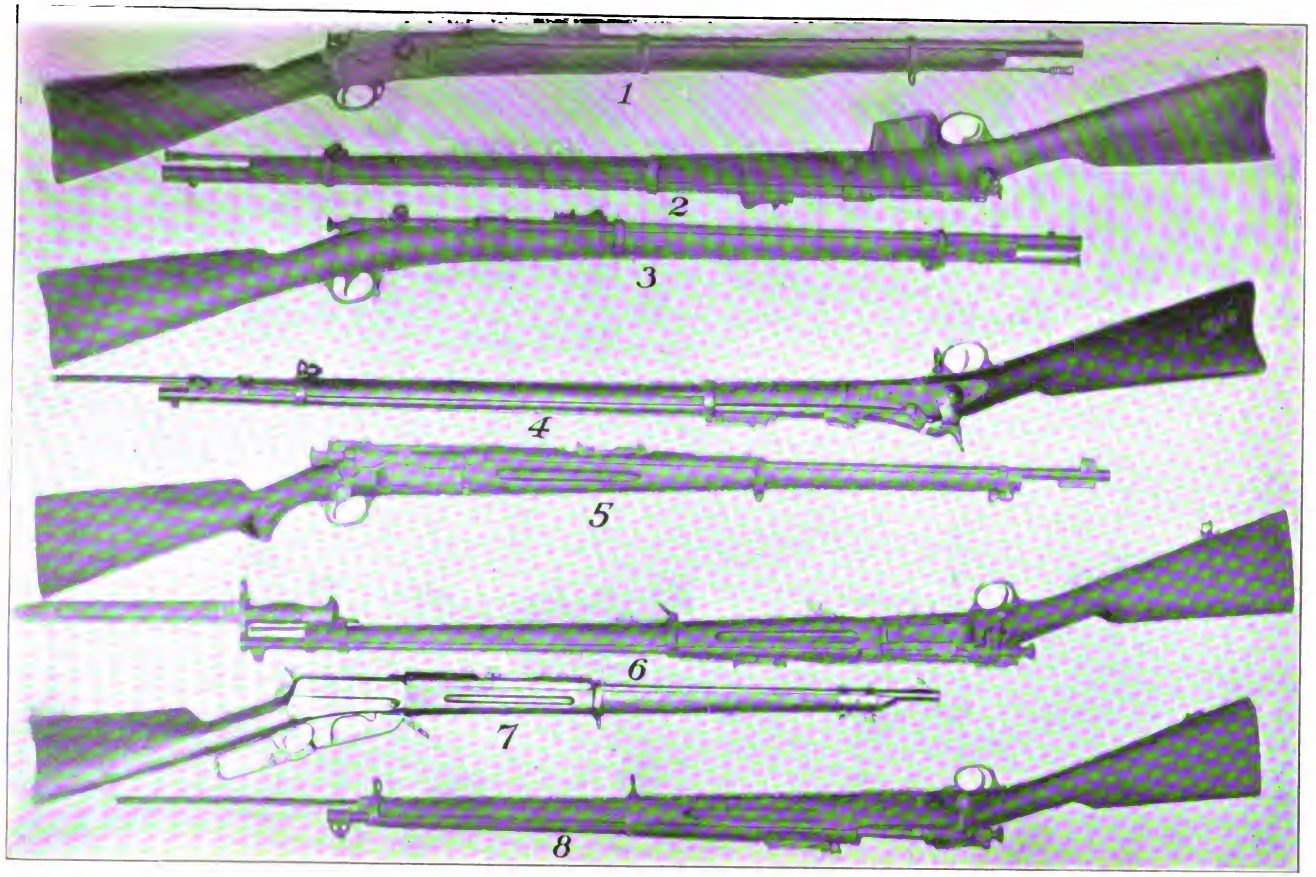

PLATE 27

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No. 2, Lee Magazine Rifle 1882. Regulation.

This is a bolt action arm feeding through a vertical slot in the receiver from a detachable magazine which is inserted from below. Several of these magazines, each holding 5 .45–70–405 cartridges, were carried by a soldier on his belt. Each magazine has a spring and follower to raise the cartridge to the chamber. Each magazine forms a part of the mechanism of the gun, and needed to be accurately made of the best materials; it was expensive, and not to be thrown away. When a magazine in a gun was empty it could be dropped out by pressing a spring; the soldier was expected to pick it up and save it to reload at some future time. Lacking a magazine, the gun could be used as a single loader. Made by Remington. Used in the War with Spain.

No. 3, Chaffee-Reece 1882. Experimental.

A few hundred were made at the Springfield Armory and issued to troops for trial in the field.

No. 4, Springfield Model 1884. Regulation.

The principal change from the preceding model lies in the cartridge, as explained further along.

Weight 9¼ pounds. Length of barrel 32.6 inches. Twist 1 turn in 22 inches. Three types of bayonets were provided: — triangular, with socket; spade or trowel with socket; cylindrical ramrod bayonet. The Buffington rear sight was our first military small arms sight to have automatic compensation for the drift of the bullet due to the spin given it by

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the rifling. The preceding models of Springfields were equipped with Buffingtons as soon after 1884 as possible.

The change to a 500 grain bullet was due to the fact that the .45–70–405 cartridge did not burn all its powder. Rather than design a new shell and rechamber all the rifles on hand to fit it a sufficient weight was added to the bullet to delay its passage along the barrel until the full action of the powder could be exerted on it.

The .45–70–500 cartridge gave a muzzle velocity averaging about 1315 f.s. and an extreme range of about 3,500 yards. Shooting at 200 yards the bullet rose about 13 inches; at 500 yards about 8 feet; at 800 yards about 25 feet; at 1,000 yards about 44 feet.

The rifle and cartridge proved capable of averaging 5-inch 10-shot groups at 200 yards under favorable conditions. A particularly well made barrel and home loaded ammunition could do much better on a calm, moist day. To squelch a Doubting Thomas who was belittling this military rifle, the author fired three shots from the hilltop where both were standing to a huge tree in the offing, and all three bullets struck the trunk of the tree within a two-foot circle; the distance, carefully measured by triangulation with a theodolite, was found to be 1,123 yards. Of course accident played the important part in this feat; nevertheless the rifle did its part, and it squelched Thomas.

Model 1884 rifles were used in the War with Spain.

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No picture. Springfield Model 1884 Sharpshooter Rifle. Regulation.

This rifle varied from the regulation service arm in being chambered for a longer cartridge, — .45–80–500 — and in having either special sights or a telescope sight.

No picture. Cadet Size Model 1884. Regulation.

Three inches shorter than the service arm; sling swivel omitted from the upper band; stacking swivel of revised form.

No. 5, Norwegian Krag. Foreign purchase.

This rifle was selected in 1892 by our Ordnance Department as the model to be copied, with very slight changes, for United States troops, and is shown as the prototype of the Springfield Model 1892 commonly called the Krag.

No. 6, Model 1892, Krag. Regulation.

This rifle is based upon the Krag-Jorgensen system, modified by U. S. Ordnance Officers in the attempt to improve it.

The magazine, holding 5 cartridges, calibre .30, is of the horizontal type, and is under the receiver and at the left side. There is a cut-off so that the rifle can be used as a single loader while the magazine is held in reserve. The weight of the rifle, empty and without bayonet, is about 9 and one-third pounds. The knife bayonet is a trifle over 11½ inches long and weighs 15½ ounces, and with its scabbard weighs 7½ ounces more.

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This is the first U. S. rifle to have the top of its barrel covered with wood for a hand guard. The twist is 1 turn in 10 inches. The cartridge shell is flanged; the bullet, of lead, rounded at the tip, with jacket of cupro-nickel, weighs 220 grains; the charge is 38 grains of smokeless powder. The muzzle velocity is about 2,000 f.s. The gun is accurate enough to hit infantry occasionally at 500 to 600 yards, and cavalry at 600 to 650 yards. The penetration of the bullet in dry oak at 3 feet from the muzzle averages about 2 feet. The trigger pull is 4½ pounds. The bolt is operated by a quarter turn to the left and a pull to the rear.

The Model 1892 Krag was considerably used by United States soldiers and sailors in the War with Spain in 1898. In the Philippines, against barbarous and semi-civilized peoples inadequately armed, it held its own. Used against the soldiers of Spain it was not accurate enough to have any especial influence, and its smokeless quality and its rapidity of fire were balanced by the same qualities in the rifles of the Spaniards. The Krag bullet, when it went sideways, did very well in the matter of execution. But for accuracy and for stopping power, the single shot .45–70–500 cartridge of the old Springfield was considerably ahead.

Model 1892 Krags were manufactured at the Springfield Armory.

No. 7, Winchester Model 1895. Regulation.

Has the unusual feature of a combination of lever

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action and box magazine. An arm, using service ammunition, much superior to the service arm made in the government shops. Much liked by those of the American forces who used it in the War with Spain.

No picture. Model 1896 Krag. Regulation.

Unsuitable material and defects in construction in the Model 1892 Rifle having become apparent, this model represents the attempted remedy.

The length and weight of the rifle, and the muzzle velocity of the bullet, all were slightly reduced. The thumb-piece of the cut-off is, in this model, made to cut off the magazine when it is down, instead of up, as with the preceding model. The long wiping rod beside the barrel of the 1892 model is in this one replaced with one in three sections carried in a recess in the butt reached through a trap door in the butt plate. The rear sight of the earlier pattern is replaced with one much better, giving a closer correction for drift up to 1,000 yards.

The Model 1896 was a considerable improvement upon the Model 1892, and was used at rifle ranges by expert shots with some degree of satisfaction. The ammunition was the same in appearance as for the preceding model but was improved slightly in proportion and workmanship. Since 1893 the powder charge had been 36 grains and the bullet weight 230 grains. But as a high power small bore military rifle embodying all known up-to-date improvements it nevertheless left much to be desired.

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No picture. Cadet Size Model 1896. Regulation. The difference between this and the regular service arm was in the bayonet and the cleaning rod, with details controlled thereby. The bayonet was about 2 inches shorter and the rod was in one piece.

No picture. Model 1898 Krag. Regulation. The principal change from the 1896 model was in the rear sight and in the modification — design and increased length — of the bayonet.

No. 8, Springfield Model 1903. Regulation. This rifle, with modifications since 1905, and called "The New Springfield," the U. S. Government has been making and issuing to the Regular Army since 1903. The former high power small bore rifles on the Krag system contained faults due to mechanical design which no amount of correcting could overcome. The Krag system was therefore abandoned and that of the Mauser adopted as a basis for building up a new and more satisfactory U. S. military rifle. The New Springfield, especially the latest, is an exceedingly good weapon; its defect is the short distance (only about 18 inches) between the sights, which greatly handicaps accuracy of aim when the target lies in the further half of the effective range.

The New Springfield is an all-service arm; that is, it serves as army and navy rifle, and for all branches of each service. To cavalry it is issued without a bayonet.

As made in 1903, 1904, and part of 1905, it had a rod-bayonet, was composed of 90 parts, weighed,

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PLATE 28

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including the rod-bayonet, 8.937 pounds, and was 43.43 inches long. Until 1906 its cartridge gave a muzzle velocity of 2,200 to 2,300 foot seconds, used 42 to 44½ grains of nitro-glycerine smokeless powder, and a lead core, cupro-nickel covered, round nosed bullet weighing 220 grains.

During the latter part of 1905 a change was made in the ammunition and small changes in the rifle, and the manufacture of The New Springfield in large quantities was begun for the entire re-arming of the Regular Army.

Plate 28

No. 1, Springfield Model 1906. Regulation. This is the 1903 arm with up-to-date modifications. As it comes from the factory it is 43.212 inches long and weighs 8.69 pounds and its knife bayonet weighs a pound in addition and has a blade 16 inches long. The rifle is sighted for ranges up to 2,850 yards and has a maximum range of about 4,890 yards. It is strong, compact, not apt to get out of order, handy, well balanced, and accurate; more accurate than the short distance between its sights permits it to be pointed. Even so handicapped an expert marksman can, under favorable conditions, make long strings of bullseyes at ranges not exceeding 1,000 yards.

The barrel is 24.006 inches long, bored .30 and rifled with 4 grooves each .004 on an inch deep, making the calibre .308. The grooves and lands are of equal width, and have a spiral of one turn in

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10 inches. The muzzle is rounded and also chambered to protect the rifling.

The action — the magazine is a vertical well at the rear of the barrel. It has a removable bottom floor plate, and also an interior movable floor plate acted upon by a Z spring to raise the ammunition to the chamber. The magazine is loaded from the top. Separate cartridges can be inserted, or 5, all held in a clip, at once. To load the rifle the handle of the bolt is turned upright (to the left) and then drawn to the rear as far as it can go, thereby exposing the opening to the magazine. A cartridge can then be put into the opening and either pushed forward into the chamber or pushed down into the magazine; or a clip of 5 cartridges can be inserted; in this latter case either tip of the clip is inserted in a notch for it in the receiver and the 5 cartridges are stripped from it by pressing downward on them with the thumb; the clip remains, sticking up from the receiver, and is thrown off by the first forward movement of the bolt. The bolt has on it and contains within it practically all the mechanism necessary for the operation of the rifle except the trigger. On the exterior of the bolt are the lugs which engage with slots in the receiver to hold the bolt in place and back up the cartridge when the bolt is in the forward position with the handle turned down, and a safety lug also in case they break; on the exterior are also the cocking piece, the sear notch, the extractor, and the sleeve containing the safety lock. Within the bolt is the striker, the firing pin, and the firing pin

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spring. The safety lock has a movable thumb piece marked on one side "Safe" and on the other "Ready." When turned with "Safe" in view the rifle cannot be discharged nor can the bolt be moved. The magazine cut-off is on the left side of the receiver. It has a movable thumb piece marked on one side "On," and on the other side "Off." When "Off" is in view the magazine is off, because the bolt cannot be drawn fully back and its front end, projecting over the rear of the upper cartridge in the magazine, prevents it from rising to the chamber. The rifle is then a single loader. When the cut-off is turned so that "On" is in view, if the bolt is drawn to the rear it is necessary in order to close the action first to depress the movable floor plate. Also if the bolt is drawn fully to the rear while cartridges are in the magazine, and it is desired to pass to single loading, first press down the top cartridge in the magazine, then slide the bolt over it, then turn the "Off." The rifle can be cocked by pulling back the cocking piece without turning or drawing the bolt. The bolt can be removed from the rifle by first turning the cut-off to its central position, then turning the bolt, then turning the safety lock to its central position, then drawing out the bolt. To take the bolt apart, hold the shank with the left hand and the cocking piece with the right hand, and with the fore part of the thumb press on the stud (sleeve lock) and twist in opposite directions at the same time. This permits unscrewing the sleeve. The bolt is now in two parts, one of which contains

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several pieces which can be separated; and the other part has as its only removable part the extractor. To get the extractor off of the bolt, turn it to the right, forcing its tongue out of its groove in the front end of the bolt, and push the extractor forward off the bolt. To separate the other large piece, hold the whole of it with the cocking piece against the breast, draw back the firing pin sleeve with the forefinger and thumb of the right hand and hold it so while removing the striker with the left hand; then slide the firing pin sleeve and the mainspring off the firing pin. With this part of the mechanism of the rifle one need go no further in cleaning the parts or replacing them if damaged. The one other part of the rifle which anybody not a gunsmith may need to remove is the magazine spring. To get at it, with the bullet end of a cartridge, or other pointed instrument, press on the catch of the floor plate through the hole in the rear end of the floor plate, while at the same time pulling to the rear; this will release the floor plate. Then raise the rear end of that part of the magazine spring which is outermost high enough to clear the lug on the floor plate and draw it out of its mortise.

In assembling the parts of the firing mechanism it is undesirable to attempt to cramp the mainspring by holding the striker with its point against any part of the person and pushing upon it against the strength of the spring; a slip has caused many a painful wound.

The stock is made of American black walnut.

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Where the barrel beds, under the butt plate, and in the grasping grooves, it is cut away as much as possible to reduce the weight. There is a hole in the butt reached through a trap door in the butt plate in which to carry either a spare part or a combination oiler and thong case.

Sights. The front sight, protected by a clip hood, is seated (and held by a pin) in a movable stud, which in turn is also seated, and secured by a pin, in a fixed stud encircling the muzzle of the barrel. The front sight is blackened and should be kept black. The rear sight is an elaborate one seated in a fixed base upon the breech of the barrel. When the leaf is down the battle sight is ready for use; it is set for 547 yards, and is for use when the enemy is within 600 yards and quick shooting is necessary, using his belt as an aiming point if he is standing; otherwise the aim should be beneath him. It is not serviceable for target use at less ranges, as, with it, the bullet would strike about 2 feet high at ranges between 200 and 400 yards.

When the leaf is raised 4 kinds of sights are available. The extreme range one, for 2,850 yards, is the notch on top of the leaf. The notch in the bar which slides up and down is for ranges between 1,400 and 2,750 yards. To set it the upper edge is aligned with the range reading on the leaf and clamped there with the side screw. Then there is the notch in the bottom of the triangular opening; this is for use between 100 and 2,450 yards. And, 4th, there is the peep sight just below it. Care must be taken

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to set exact alignment of index lines and range reading lines. A setting error of the width of one of the lines is sufficient to cause 8 inches of error at a 500-yard target. The scales of the various ranges have odd numbered hundreds of yards at the right side and even numbered at the left; the line below the number is the one to use for that range. The wind gage is adjusted by the screw at the front right side of the sight base. When the movable base is screwed to either side the rifle shoots to that side. A graduation on the wind gage scale is called a "point." A change of one point changes the hit 4 inches for every hundred yards of range. The front sight should always be seen in the exact center of the rear sight, with its top level with the top of the rear sight notch or with the center of the peep hole.

The bayonet, Model 1905, is of the sword pattern, and is for both cutting and thrusting. The blade is 16 inches long, sharpened along one edge for 14½ inches and along the other for about 5½ inches, and grooved both sides. Attachment to the rifle is effected at two places, a ring in the guard which slips over the muzzle and a slot in the handle which receives a lug on the right side of the barrel. Without the scabbard the weight of the bayonet is 1 pound.

Ammunition. The *service* cartridge holds 47 to 50 grains of pyrocellulose, the exact amount varying according to the strength; that amount is used which gives the bullet a muzzle velocity of 2,700 foot seconds. The powder is granular, each grain being a small perforated cylinder, graphited to help resist

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moisture. The percussion composition of the primer weighs .46 of a grain, and is composed of tersulphide of antimony, potassium chlorate, and sulphur. The bullet weighs 150 grains. It has a sharp point to minimize air resistance. The core of the bullet is lead and the jacket cupro-nickel.

The *blank* cartridge, Model 1909, is without a bullet. One of the preceding types of blank cartridges used a wax bullet which in mimic warfare injured uncovered parts of the body when fired close to; another used a paper bullet containing 6 grains of " E. C." smokeless to break it up; neither of these types is now made. The present blank cartridge contains 12 grains of " E. C." in a second hand shell, the mouth of which is closed with a paper, cup-shaped wad, shellacked to make it waterproof.

The *dummy* cartridge is without powder or priming composition. The case is tinned and has 6 longitudinal cannelures and 3 circular holes; it is very evidently a dummy both to sight and touch. The bullet is regular.

The *guard* cartridge, for use on guard duty at short range, and against riots in thickly populated regions, is not a long range one. It has about 9 grains of Bullseye powder or about 16½ grains of DuPont No. 1 Rifle Smokeless, which gives its regulation bullet a muzzle velocity of about 1,200 foot seconds. It is a fairly good short range target cartridge. Used at 100 yards the sight should be set at the 450 yard line; at 200 yards at the 650 line;

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at 300 yards at the 850 yard line. The guard cartridge can be distinguished by its 6 longitudinal corrugations extending for $\frac{3}{16}$ of an inch backward from the shoulder.

The *rifle grenade* cartridge is a special blank cartridge of recent design, used for throwing a comparatively heavy charge of high explosive contained in a cast iron can. The grenade weighs, in present form, nearly a pound and a half. Both propulsion and ignition are conveyed to it from the cartridge by means of a hollow metallic stem which extends down the rifle barrel from the grenade which rests on the muzzle of the rifle. This newly designed blank cartridge weighs 210 grains and contains sufficient powder to exert a chamber pressure of 48,000 pounds to the square inch.

Service ammunition ballistics. Speed of fire: an expert can fire about 25 aimed shots per minute, or 40 shots from the hip. Accuracy: except at very short range the rifle is not pointed directly at the point to be hit. Beyond about 50 yards the combination of flip, jump, drift, wind-drift, atmospheric influences, etc., causes the bullet to leave the vertical plain in which the axis of the barrel lies and travel a rather devious path. But this of course is true of the actions of all rifle bullets. Accuracy means, rather, the ability of arm and ammunition to perform the same feats alike under the same conditions. And this The New Springfield — and its ammunition — does very well indeed. Given like conditions, the chamber pressure of 51,000 pounds per square

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inch, and the maximum flight of the bullet when started at 45°, about 4,891 yards, remain approximately constant during a long series of repetitions: and also a series of bullets intercepted at one spot anywhere in flight make a close grouping of hits. This arm and its ammunition are therefore well coordinated.

The kick of the rifle is about 15 foot pounds. The penetration in white pine at 100 yards averages about 58 inches; at 500 yards about 26 inches; at 1,000 yards about 10½ inches. Into ordinary earth it will penetrate at 500 yards about 2 feet, at shorter and longer ranges less, because at 500 yards its velocity is right for its shape for boring into earth. In steel its penetration is best at only 50 feet; at that distance the bullet will go entirely through a little over ½ inch of low steel. In brick its penetration is best at 100 yards; at that distance the bullet enters 5½ inches. The rifle is therefore dangerous to an enemy screened by a large tree, a house, or a small bank of earth; and behind a 12-inch brick wall an enemy could be disabled by the 3d shot hitting the same spot.

All of the foregoing data regarding our government's present military arms are of course public property, because any expert can produce them by examining and firing the rifle. Besides these data our Ordnance officers have made carefully computed and verified ballistical tables which enable a commanding officer, by reference to them after inspection of local atmospheric conditions, to order sight

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settings which will enable his platoons to find their targets at any distance without waste of much time and ammunition.

These tables cover the ordinates of trajectory above the line of sight for distances between 100 and 3,100 yards; danger zones for infantry and cavalry, within point blank, rising and falling fire; time of flight of bullet, angle of fall, remaining velocity, etc.; what to allow for drift and jump, and for various velocities of wind and for temperature, moisture, and atmospheric weight. If by the layman regarded with suspicion, they nevertheless are eloquent testimonials of the extent to which science has by the present generation been applied to rifle shooting.

The Model 1906 Springfield was used by United States troops in the World War. At the declaration of war in 1917 there were on hand about 600,000; during war the number made was 312,878. These were manufactured complete at the Springfield Armory, and in parts at the Rock Island Arsenal.

The '06 Springfield, with selected service ammunition, is proudly proclaimed by our Ordnance officers to be the best military rifle in the world. It is. It and all the others are about of a standard, but the '06 is a bit better in the matter of unfailing service, accuracy at long range, speed, and low trajectory. However, if all modern military rifles are averaged for a standard, ours is only a small per cent above standard: not sufficient to dominate the other military rifles under battle conditions.

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No. 2, Model 1917. Regulation. The Model 1917 rifle is similar to the Improved British Enfield, but differs from the latter in using calibre .30 U. S. ammunition instead of .303 British. With its bayonet attached it weighs about 11 pounds, and is not only heavier than the Springfield, but also longer.

The barrel, about 2 inches longer than the Springfield barrel, is rifled with 5 grooves which have a right to left pitch. In calibre, and in twist, — 1 turn in 10 inches, — the '06 and the '17 rifles are alike.

The action differs from that of the Springfield in only two features of importance, one being that cocking occurs with the forward movement of the bolt and the other that cocking can be done only by bolt movement, because there is no cocking piece to be pulled back by the thumb and finger.

The stock has a pistol grip, and a reach, measured from butt plate to trigger centers, about an inch greater than that of the Springfield.

The sights, judging only by the short experience with them, are considered the best we have found. They are simpler, further apart, and better protected than those on the Springfield. The rear sight has but one kind of eye-piece, a ring, for both short and long range. Battle sight is for 400 yards.

The bayonet is in general design similar to that for the Springfield, but is an inch longer in the blade, 17 inches.

The ballistical qualities of the rifle are not yet fully formulated, owing to its short service. They

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are of course more or less individual, because any change in a rifle barrel and its kind, position and strength of supports in the frame and stock causes changes in flip and direction of recoil and therefore affect the flight of the bullet. Experience with this rifle to date indicates that it is good, but it is not liked as well as the '06 Springfield.

The Model 1917 rifle was used by United States troops in the World War. The number made was about 2,300,000, produced by the Winchester Repeating Arms Co., at New Haven, and by the Remington Company at Eddystone and Ilion.

No. 3, Model 1918. Automatic. The specimen illustrated was among the first 100 made; those of later issue were externally modified, as shown by the outline drawing below the picture.

Another name now in use for this rifle is "The Light Browning Machine Rifle." This automatic rifle uses magazines of two sizes, one holding ten and the other twenty '06 cartridges. It may be used as a single shot, a repeater or an automatic; with deliberate aim from the shoulder or as a hose from the hip or the shoulder; for one shot, for a short series, or for the whole magazine.

As made at present it weighs 15 pounds 15 ounces unloaded, but as its development proceeds its weight may be considerably lessened. It is gas operated and air cooled, and serviceable even after one hundred shots have been fired at top speed. Its speed of fire is at the rate of about 480 shots per minute;

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the speed can be, and perhaps will be, increased by slight changes in the mechanism.

The first shot is obtained by starting the mechanism by hand, using the cocking handle on the left side of the frame. Subsequently it functions automatically, using for power a portion of the gas of explosion taken from the barrel as the bullet nears the muzzle.

As made at present the piston rod and the slide are carefully aligned and then rigidly connected. It seems likely that a ball and socket, or a universal joint, would give better results there, because it would work equally well while the gas cylinder tube is in line and would allow functioning also when accident had thrown the gas cylinder tube slightly out of line; also the present delay in and expense of guaging would be abolished. The slide seems unnecessarily strong and heavy, and can be made either hollow or channeled for the sake of lightness and speed. The frame, hammer and link also contain surplus weight and metal.

The recoil of this arm is a push instead of a blow, and the steady push of twenty cartridges fired at full speed tends to twist the user and the gun around to the right, and to necessitate a step backward; these oddities immediately strike the attention of the novice, but do not prevent the experienced man from using the rifle expertly. A much more interesting feature is the generation of electricity by this rifle, sufficient in amount to charge the operator, from whom a spark or a light shock may emanate

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upon near or actual contact. Suggestions are in order for utilizing this adjunct, particularly concerning heat absorption.

The Model 1918 Rifle is not intended to replace or even compete with heavy water-cooled machine rifles; it has its own particular spheres of service. Doubtless it will soon be adapted to sporting uses.

The Model 1918 Rifle was used by the United States troops in the World War.

No. 4, Model 1917–19. Sniper. This arm has the action and the external barrel-dimensions of the regulation Model 1917 rifle. The bore, chamber and grooves are of the Model '06 pattern, and of star-gage quality, that is, of extra accurate workmanship.

The butt stock is a special one, having a high comb and a full pistol grip; and the fore stock extends only about half way along the barrel.

The sight is a telescope of about 2 and a half power, very clear.

A few of these rifles were ready for issue in 1919; the original intention was to issue fifty thousand of them; whether that number or a tenth part of it will be made is at present undecided.

From these descriptions of our present military rifles the reader will assume that our country is adequately armed. It is not. Our rifles are just now as good as those of other nations, but ours and theirs are all of one grade of mediocrity; they were inadequate to the needs of the World War; they will be obsolete in the next war.

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Other nations, realizing the present dead-level of all infantry armament, have set their ablest engineers to follow the clew that will give leadership; for self-preservation's sake it is our obligation to go them one better. It can be done by developing the plans broadly sketched in the final chapter.

Meantime, assuming that we must hold awhile longer to our present types, let us at least be the first to make them less conspicuous. We are clothing and equipping a soldier with colors of minimum visibility; we are at the same time making him a prominent mark in the landscape with a dark brown and blue-black weapon. If a soldier is to be olive-drab, of course his rifle should be olive-drab, lock, stock and barrel. Other nations will do it; let us do it first.

RIFLES USED BY OUR ALLIES

Who Participated in Actual Fighting in the World War

Comparison of all the modern rifles used in the World War reveals dead uniformity on both sides. Excepting the U. S. Model 1918 Automatic, all were bolt action and followed closely the generalities of the superannuated Mauser. Such a condition reveals a long-continued and very bad state of stagnation in arms development. Of course it is axiomatic that had any nation at the beginning of war possessed a radically better weapon and a soldiery who were masters of it the war would have had a

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quick finish. But mediocrity among widely scattered units passes unnoticed; it is only when all are marshalled for review that mediocrity obtrudes itself. From the review which follows there is but one valuable fact to be learned, and that is a warning: *now is the time of change.*

Plate 29

Great Britain

No. 1, Lee-Enfield, Long Pattern, Mark 1, 1907. Calibre .303 or 7.7 mm. Box magazine holding 10 cartridges in two columns of five each. Length 4 ft, 1½ inches. Weight about 9 pounds, 4 ounces. Length of latest sword bayonet 1 foot 5.2 inches. Bullet velocity, latest, about 2,340 f.s.

A small pattern of this rifle called the Short Enfield, Mark 111, using the same ammunition, is described under Carbines, although it was equally an infantry arm.

These two patterns of rifles were used in the World War by Great Britain and her Colonial troops, except that at the beginning her Canadians used the Ross rifle (see page 267).

France

No. 2, Lebel rifle, adopted in 1886; the first small bore rifle (black powder) of any nation, and the first to use smokeless powder. Calibre 8 mm., or .315. Eight cartridges are carried in a tubular magazine below the barrel; with one in the receiver and one in the barrel 10 are the total. Length of

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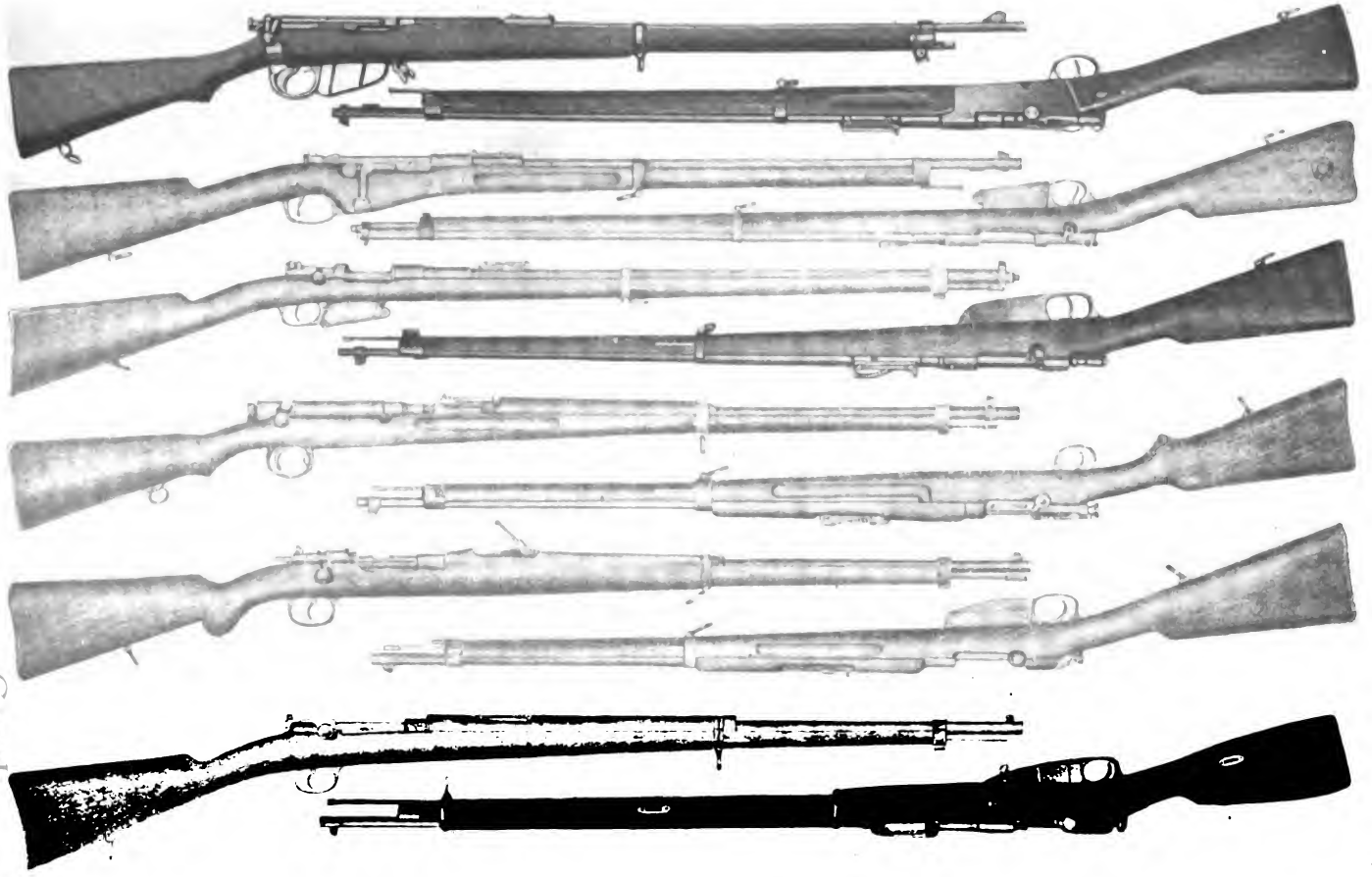

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rifle 4 feet 3.12 inches. Length of bayonet 1 foot 8.72 inches. Weight without bayonet 9 pounds 3½ ounces. Four grooves with one turn in about 9½ inches. Boat shaped bullet (Balle D) of solid bronze (copper and zinc), having velocity in 1914 of about 2,300 f.s. For this shape of bullet slightly greater velocity and accuracy and lower trajectory is claimed for ranges exceeding 1,000 yards.

No. 3, Berthier-Lebel rifle; said to have been developed during the first year of the war, combining the good points of the Lebel rifle and the Berthier carbine. 8 mm. Box magazine carrying at first 3 and later 5 cartridges.

Besides these arms for front line troops, obsolete arms were taken from storage and issued to home-guards and other non-combatant troops.

Belgium

No. 4, Mauser-Lee, pattern of 1889 with slight modifications. Calibre 7.65 mm. or .301. Box magazine holding 5 cartridges. Length 4 feet, 2¼ inches. Weight about 8 pounds. Length of bayonet 9½ inches. Four grooves, twist 1 in 9.82 inches. Velocity in 1914 about 2,050 f.s. The barrel, very light, is encased in a thin steel tube surrounding an air space between it and the barrel; this feature does not meet general approval and by other nations was abandoned long ago.

No. 5, New Belgian rifle. Made in America during the war; marked "Hopkins & Allen Co.,

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Norwich, Conn." Merely a Mauser-Lee with comparatively unimportant changes.

Besides these two rifles of the regular army the Civil Guard was, at least at the beginning of the war, armed with two obsoletes; one was the Comblain, a single shot .43 calibre falling breech block arm dating back to 1868. This rifle had a 33-inch barrel, weighed 9½ pounds, and used black powder and lead bullet. The other was the Braendlin-Albini of the same period, calibre, and kind of ammunition. The barrel length was 34¾ inches with one twist in 21¼ inches; the weight 10 pounds; the cartridge held 80 grains of black powder and a 386 grain soft lead bullet. With these two old guns the Civil Guard killed about as many of the enemy as the enemy with his Mausers damaged in return.

Italy

No. 6, Mannlicher-Carcano, 1891. Calibre 6.5 mm. or .256. Box magazine, 6 shots. Weight about 8 pounds, 6 ounces. Length 4 feet 2¾ inches. Length of bayonet about 11¼ inches. Velocity in 1914 about 2,400 f.s. Gain twist grooving, from one in 22.9 inches to 1 in 7.5 inches. Another oddity is a rotating extractor travelling partly around the head of a cartridge when the bolt is turned.

Japan

No. 7, Arisaka or Year 38 rifle. 1907. In design practically a Mauser. Calibre 6.5 mm. or .256. Box magazine, 5 shots. Weight 8 pounds, 10

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ounces. Length 4 feet 2¾ inches. Length of bayonet about 1 foot 3 inches. Velocity in 1914 about 2,400 f.s. Its use in the World War was against Germany's Asiatic Colonies.

Portugal

No. 8, Mannlicher-Verguiero, 1904. Calibre 6.5 mm. or .256. Box magazine, 5 shots. Weight 8 pounds 13 ounces. Length 4 feet. Length of bayonet 11¼ inches. Velocity in 1914 about 2,350 f.s.

Greece

No. 9, Mannlicher-Schoenauer, adopted 1906. Calibre 6.5 mm. or .256. Box magazine with rotating platform; 5 shots. Weight 8 pounds 5½ ounces. Length 4 feet and ⅜ of an inch. Length of bayonet about 9¾ inches. Velocity in 1914 about 2,220 f.s.

Rumania

No. 10, Mannlicher, 1893. Calibre 6.5 mm. or .256. Box magazine, 5 shots. Weight 8 pounds 12¾ ounces. Length 4 feet ½ inch. Length of bayonet 9¾ inches. Velocity in 1914 about 2,400 f.s. This Rumanian variant of the Mannlicher has a rotating instead of a straight pull bolt.

Besides this, the official arm, the irregular soldiers of Rumania used obsoletes and antiques, even doing considerable execution with cap lock and flint lock muzzle loaders.

Serbia

No. 11, Mauser, 1899. Calibre 7 mm. or .276. Box magazine, 5 shots. Weight 9 pounds, 6 ounces. Velocity about 2,250 f.s.

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Montenegro

The same as Russia. See No. 12.

Russia

No. 12, Mossin, more commonly called Three Line Nagant. 1900. Calibre 7.62 mm or .30. Box magazine, 5 shots. Weight about 9 pounds. Length 4 feet, 3.875 inches. Length of triangular, socket, bayonet 1 foot, $5\frac{1}{8}$ inches. Velocity in 1914 about 2,390 f.s. This rifle follows patterns 1891 and 1894 of the same general type. As the supply of Mossins was entirely inadequate, Russia bought abroad practically anything in the way of a rifle that would shoot, and many regiments became armed with discarded Springfields, not alone the good old single shot 45–70 breech loader, but to a far greater extent with the more ancient .58 calibre muzzle loaders.

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PLATE 30

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Chapter II

RIFLES USED AGAINST THE UNITED STATES SINCE 1800

Plate 30

The Rifle of the British in Our War of 1812

No. 1, The Baker rifle. After a rather discouraging review of the military rifles of the present day it is refreshing to turn once more to the elementary arms of past generations. We of the present have at hand a large accumulation of basic ballistical knowledge and a present and future of immense opportunity in the realm of general science applicable to small-arms, and yet in fatuous conceit we are standing still. Our forbears, however, started with almost nothing in the way of knowledge of ballistics and little understanding of the realm of the rifle as opposed to that of the smooth bore, and their groping progress is as interesting as a journey in a new country.

Before 1800 the only military rifle used by British soldiery was the Ferguson, and that to the extent of only a couple of hundred or thereabouts. But during the War of 1775 to 1783 between Great Britain and the United States there was in Great Britain, and especially in Parliament, much public discussion in regard to " the remarkable properties of those strange rifled arms used with such deadly certainty by several regiments of the American army."

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By the close of the 18th Century, Parliament and the War Office had decided that rifles were necessary innovations, and with the view of equipping a regiment with such new-fangled arms the War Office invited British gunmakers to submit specimens to an open competition. At the same time sample American and German rifles were gathered, and in the competitive trials these were pitted against the home products.

The result of this test was rather amazing, for the award of an order for 1,000 military rifles fell to Ezekiel Baker, a London gunmaker, whose sample not only ignored all the good qualities developed in American Kentuckies but copied closely the ancient German type from which the Kentucky was developed, and even went further and exaggerated its defects.

So Great Britain started, with the Baker rifle Model 1800, where Kentucky rifles left off about 1730; and by examination of it in detail the reason of its lack of influence in the War of 1812 is readily seen.

In the first place its marks of identification, then its dimensions corresponding with those of record, and then its virtues or lack of them: — the lock plate is marked " E. Baker & Negus, 1802 "; the barrel is stamped " E. Baker, 1802," and Birmingham proof marks of the pre-1813 pattern.

The total length is 3 feet, 9¼ inches. The weight is about 8¼ pounds. The balancing point is about 6½ inches in front of the trigger guard, nearly under

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the rear sight. The barrel, of stub twist, is practically 30 inches long, and is bored and grooved to about $\frac{11}{16}$ of an inch to use a spherical bullet of 14 to the pound, a little greater in diameter than the diameter of the bore including the depth of the grooves. Its muzzle is considerably funneled to facilitate the entrance of the ball, and on the right side there is a slide bar and hook for the bayonet — a 17-inch triangular bayonet. There are 7 grooves, shallow for that period, and they and the lands are of equal width; their spiral makes a quarter turn in the length of the barrel, or a complete turn in ten feet. The front sight is of knife blade pattern, brass, small, and set at the tip of the muzzle. The rear sight, in addition to the usual fixed notch, has two folding leaves, marked for 100 and 200 yards.

The stock is of black walnut, highly polished. It holds the barrel by a hook to the standing breech and by three sliding keys beneath its length. It has brass furniture, iron sling swivels of Brown Bess pattern, and a stout steel ramrod which at the small end has an interior thread for a ball screw and a greaser, carried in a trap in the butt, and at the head end a flattened knob and a hole for tying a rag to wipe the bore.

The lock, of detanted type, is of superior workmanship. An interesting and uncommon feature is a hole through the lock plate in such a place that when the mainspring is cramped by cocking, a peg put through the hole holds the mainspring cramped so that the lock may be taken apart without the use

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of a spring vise. The hole is ordinarily kept plugged with beeswax.

The bullet for this rifle was of 14 guage, the diameter being .713 and the weight 500 grains. The regulation powder charge was 4 drams. The recoil was — ouch!!! The price paid to Mr. Baker for each rifle and bayonet was 4 pounds, 8 shillings, 3 pence; translated into money value of the present day it would be about $100.

The specimen described and illustrated is at present writing 118 years old. In appearance outside and inside it is about as brand new. How it came to America and when, and how it happened to remain unused, is unknown. It was found standing in a corner of the office of an ancient and defunct firm formerly in the raw fur business; a century or more ago it had been thoroughly coated with tallow and when salvaged it was so covered with cobwebs and dust that its identity was at first unsuspected. When washed with gasoline its protective but hideous coating sloughed off and its former surfacing, unmarred by dents, scratches, wear, or rust, gave its new owner unexpected delight.

In the War of 1812 besides this Model 1800 Baker rifle there was the Baker Model 1802. This second British army rifle differed from the first so little in appearance that the picture of one serves for the other. In the Model 1802 there was a reduction of calibre to 20 balls to the pound, and the bayonet was changed to the sword type, 23½ inches long, sharp along one edge. Ballistically this second rifle was

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distinctly an improvement upon the first, although by no means up to what it should have been.

The Model 1800 Baker rifle fired an unduly heavy charge for its weight, yet the proportion of powder to lead was not such as to give high speed; hence its trajectory was high even over short ranges. As it used an over-size ball its 95th Regiment soldier user was obliged to carry a small wooden mallet and a short iron loading stick wherewith to start the bullet down the barrel before the heavy iron ramrod began its share of the labor of pounding and distorting and driving the bullet. A clean bore was hard and slow to load and on a dry day a used bore was almost impossible. Soldiers complained that they were obliged to sacrifice bits of their scanty linen and liberal amounts of saliva for cleaning purposes between each shot, and were able to average only about one shot to each ten minutes.

If properly loaded and aimed, the rifle was capable of hitting a man at 200 yards about 8 shots out of 10. But the rifle was rarely well aimed, first, because the stock was so straight that only an abnormally short necked man could readily use the rear sight; and second, because the recoil was so severe that after the first shot a soldier was unlikely to take pains with the aim of succeeding shots.

The Model 1802 Baker rifle not only used a lighter bullet but also an undersized one, provided with a circular greased linen patch. This permitted the mallet and loading stick to be discarded and increased the firing speed. Other defects, however,

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remained, and the Model 1802 was not all, nor anywhere near all, that a military rifle of its time should have been.

However, comparison of our own Model 1800 rifle with the two Baker rifles shows that American skill, vaunted at that time, in the making and using of rifles was not shared by those designing them for military use; and the famous rifle battle of the 1812 war, the Battle of New Orleans, was one in which the prestige of sporting and not military arms has come down to the present day.

The 1847 War with Mexico. The very few rifles used by Mexican soldiers were Kentuckies, made in the United States and obtained for the most part from captured civilians.

Civil War Rifles of the Confederate States.

In 1861 the Confederate States were obliged to refuse regiment after regiment because there were no arms for them. Its arsenals were simply storehouses; it had not one factory, public or private, where either military or sporting arms were manufactured in quantities; the various states had been purchasing their militia supplies from the United States Government, which, in turn, had purchased them of civilian manufacturers in the North.

Just before war was declared the United States Government had transferred to southern arsenals a portion of the overstock that had been located at various arsenals in the North; and various southern states made requisitions on the United States Gov-

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vernment for, and received, arms due them because payment had been made for them. When hostilities started the Confederate States had about 150,000 shoulder arms, of which about 130,000 were muskets altered from flint lock, and only about 20,000 were rifles or rifled muskets. These 20,000 were of all the flint lock and cap lock varieties up to and including Model 1855.

To arm the soldiers of the Confederacy there resulted three classes of procedure: —1st, with sporting arms, including shotguns, requisitioned from the people. 2d, by purchase abroad. About 25,000 British military rifles, of Enfield and civilian make, were secured and issued; also about 160,000 French, Belgian, German and Austrian rifles and rifled muskets. 3d, by the establishment of armories for both repairing and manufacturing. Arms injured in Confederate service and also battlefield pick-ups were repaired in multitudes of shops, the largest being that of Samuel Sutherland of Richmond, Virginia. Gunmaking machinery captured from the Harpers Ferry arsenal was distributed to newly organized factories, that in Fayetteville, North Carolina, to make rifles of calibre .54, and that in Richmond to make .58 calibre ones. Besides those two places, rifles in considerable numbers were made by Major Hill, at Tyler, Texas, whose output was stamped "Texas Rifle Tyler"; by W. S. McElwaine, proprietor of an armory at Holly Springs, Mississippi; by J. P. Murray of Columbus, Georgia, and by Dickson, Nelson & Co., of Alabama.

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The stamp of the Confederate States, not always, however, put on their arms, was " C. S. A." The number of new arms of all kinds made in the Confederacy is generally conceded to have been about 40,000; this number includes rifles, rifled muskets, smooth bore muskets, musketoons, carbines, revolvers, and pistols; of rifles and rifled muskets alone it is not probable that more than 12,000 were made.

Since the Confederate States and the Federal States were equipped, for the most part, with the same kinds of rifles, those which were not radically different from the ones in use by the soldiers of the North are now of minor interest. Those which were individually Confederate — that is, peculiar rifles used by the South and not by the North — were, so far as now known, of but three kinds: the muzzle loading Hall, the Whitworth snipper, and the Le Mat. The Le Mat is shown on Plate 8, No. 7.

No. 2, Re-built Hall Rifle, muzzle loader. This is one of the curiosities of the war, for it is the only instance on record of the deliberate conversion of a breech loader to a muzzle loader.

No. 3, Whitworth Snipper Rifle. Purchased in England and transported to the Confederacy on blockade runners. Number which were issued for service, 300. Hexagonal bore, called .45 calibre, using an elongated bullet cast and then swaged to the shape of the bore. Heavy barrel. Good telescope and mountings. Accurate and powerful at

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half a mile and responsible for the taking off of many a Federal officer.

CONFEDERATE STATES

Manufacturers and Repairers of Rifled Shoulder Arms (the period of the Confederate States was from 1861 to 1865).

Maker	Place	Note
Beech & Rigdon, or Leech & Rigdon	Augusta, Ga.	
C. Chapman	——?	
Cook & Bro.	New Orleans, before 1863. Athens, Ga. 1863–1866.	
Dickson, Nelson & Co.	——? Alabama	
Fayetteville Arsenal	Fayetteville, N. C.	
Wm. Glaze & Co.	Columbia S. C.	Sometimes stamped his work with this name and sometimes "Palmetto Armory."
Hyde & Goodrich	New Orleans, La.	
W. S. McElwaine	Holly Springs, Miss.	Died 1882.
Mendenhall, James & Gardner	Greensboro, N. C.	Contract with N. C. for 10,000 rifles. Marks, "M. J. & G."
Morse	Augusta, Ga. Columbia, S. C.	Carbines
J. P. Murray	Columbus, Ga.	
Palmetto Armory	Columbia, S. C.	Wm. Glaze, Proprietor
J. C. Peck	Atlanta, Ga.	Specialty, rampart rifles
T. W. Radcliffe	Columbia, S. C.	Both maker and importer.
Richmond Armory	Richmond, Va.	
Thomas Riggins	Knoxville, Tenn.	
S. G. Robinson	Richmond, Va.	Marks, "Robinson Arms Co."
Spiller & Burr	Macon, Ga.	
State Rifle Works	Greenville, S. C.	
Shakanoosa Arms Mfg. Co.		

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Maker	Place	Note
Samuel Sutherland	Richmond, Va.	
George Todd	Austin, Tex.	
Tapley,	——	Specialty, carbines.
Tyler Arsenal	Tyler, Tex.	Marks, " Texas Rifle. Tyler, C. S."
Union Mfg. Co.	Richmond, Va.	G. P. Sloat, formerly of Phila., Supt.
Virginia Manufactory	Richmond, Va.	

War of 1898 Rifles of Spain

No. 4, Spain used the widely known Mauser rifle, pattern of 1892. The Spanish Mauser was about 49 inches long, had a barrel length of about 28 inches, weighed about 8½ pounds, and was of calibre 7 mm. Nearly all were marked " Loewe & Co., Berlin." Of rifles and carbines together the United States captured between twenty-one and twenty-two thousand. Many thousand of them, in almost new condition, were refinished at our Springfield Armory, giving the Ordnance officers in command there the opportunity to compare them in detail with our Krag, to the disadvantage of the Krag. One result of refinishing those arms at Springfield was our Model 1903 rifle — practically a Mauser.

Rifles of the Central Powers in the World War

Germany

No. 5, Mauser, Model 1898, with recent improvements. 7.9 m/m/, or .311, box magazine, 5 shots. Velocity in 1914 about 2,860 f.s. Length 4 feet, 1.4 inches. Length of the slender sword bayonet 1 foot,

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8.25 inches. Length of barrel 29 inches; 4 grooves; twist 1 in $9\frac{3}{8}$ inches.

Austria and Bulgaria

No. 6, Mannlicher, Model 1895, with recent improvements. 8 m/m/ or .315, box magazine, 5 shots. Velocity in 1914 about 2,870 f.s. Length 4 feet 2 inches. Length of knife bayonet 9.5 inches. Barrel length 30 inches; 4 grooves; twist 1 in $9\frac{3}{4}$ inches. Weight $8\frac{3}{4}$ pounds.

Turkey

No. 7, Mauser, Model 1893. 7.65 mm. or .301, box magazine, 5 shots. Velocity in 1914 about 2,065 f.s. Length 4 feet, 6 inches. Length of sword bayonet 1 foot, 6 inches. Barrel length 30 inches; grooves; twist 1 in 10 inches. Weight 9 pounds, 1 ounce. Weight of bullet 112 grains; steel clad and copper plated.

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Chapter III

RIFLED CARBINES

Only such rifled carbines are here treated as had considerable United States use, or else, because of their points of excellence, influenced patterns of later importance. Many queer carbines which may be seen in the Smithsonian Institution, in Washington, where inventors' models are deposited, are omitted from this treatise because they contributed nothing of importance.

Previous to the Hall flint lock breech loaders the United States issued no rifled carbines and our Cavalry used smooth bores. But before the days of the Hall, for instance in 1812 War time and in the Indian troubles, our government at times enlisted civilian mounted troops armed with their own Kentucky rifles, so that rifled arms, although not carbines strictly speaking, were used by our cavalry a century and more ago.

The Mexican War of 1847 witnessed the first use of rifled carbines by the cavalry of both our regular army and our militia, and the Civil War marked their first use by American troops on a huge scale and their evolution from the embryo to the mature weapon.

It is safe to assume that all types of carbines made in the United States before 1848 were used in the Mexican War, and that such arms and also all others made before 1865 were used in the Civil War.

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In the Civil War, Federal Troops used arms made in the government armories, or made for the government by contractors, or purchased by the government from foreign nations. State troops, on the other hand, usually were armed according to the choice of officers or men, and the arms were the property of either the state or the individuals bearing them, and did not belong to the United States Government. Thus it was possible for a regiment of cavalry composed perhaps of eight troops from as many sections of a state to be armed with eight different kinds of carbines. And, further yet, such militia carbines, the Whittier, the Perry, and the Henry, for instance, would be quite unknown to Federal Troops.

For the Federal Troops our government purchased to issue during the Civil War about four hundred thousand carbines, itemized as follows: — Ball, 1,002; Ballard, 1,059; Burnside, 55,567; Cosmopolitan, 9,342; Gallager, 22,728; Gibbs, 1,052; Hall, 3,520; Joslyn, 11,261; Lindner, 892; Maynard, 20,002; Merrill, 14,495; Palmer, 1,001; Remington, 20,000; Sharps, 80,512; Smith, 30,062; Spencer, 94,156; Starr, 25,603; Warner, 4,001; Wesson, 151.

The best military arms used in the Civil War were the Henry, used by about ten thousand State Troops, and the Spencer, used by more than ten times as many Federal Troops. The Henry rifle, — there was no difference then, as only one kind of Henry was being made, between Henry for infantry and Henry for cavalry, — with twelve cartridges in the

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magazine and one in the barrel, could be fired twenty-five times per minute. The Spencer, holding seven cartridges in the magazine and one in the barrel, could be fired fifteen times a minute, until a cartridge box was invented holding 10 tin tubes, each containing 7 cartridges which could be shoved into the magazine instantly, when the Spencer became a rival of the Henry in rapidity of fire.

But the Spencer arm was of uncouth appearance, while the Henry, functioning fully as well, was built on long, simple lines, and was a sightly object. So the Spencer went the way of all monstrosities, while the Henry, slightly modified and re-named the Winchester, survived, and is, even now, an admirable arm for short range sporting purposes.

From the Civil War to the present day the tendency has grown stronger to arm all branches of the service alike. Little by little the cycle has been completed, until now, as in the days of the Kentucky rifle, cavalry and infantry again use a rifle alike for both.

Plate 31

No. 1, Hall. 1st type. Marked "J. H. Hall, Harpers Ferry, 1833." Resembles the rifle in the manner of releasing and locking the breech. The length is 45 inches; length of barrel 26 inches; calibre .54. The ramrod-bayonet when drawn out extends 21½ inches.

No. 2, Hall. 2d type. Marked "S. North, Middletown, Conn., 1839." The length is 40 inches;

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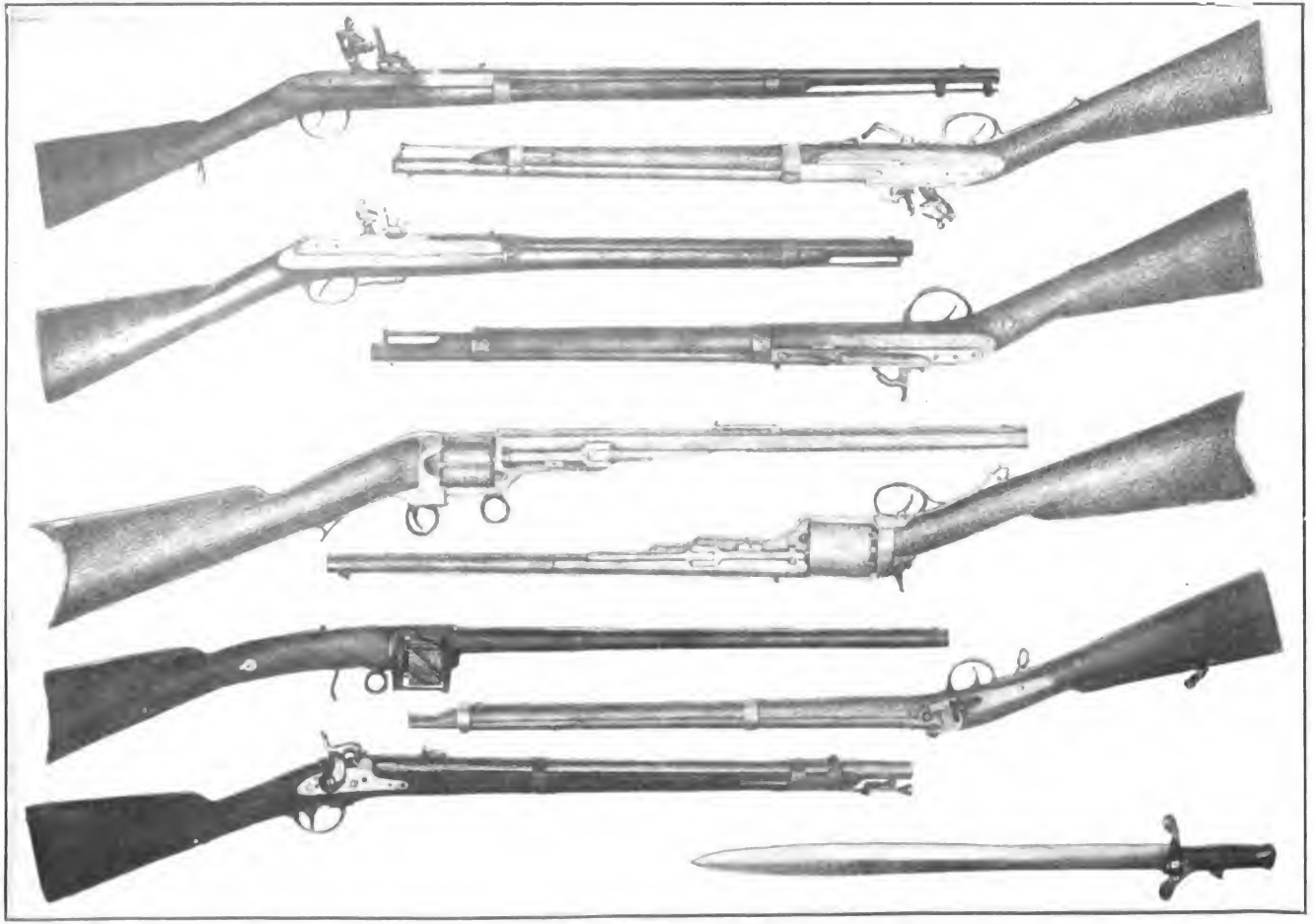

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length of barrel 21 inches; calibre .54. The hook-shaped catch for the preceding pattern having not only proved inconvenient for the cavalryman but also capable of inflicting troublesome wounds, a remedy was sought in this device.

No. 3, Hall. 3d type. Marked "S. North, Middletown, Conn., 1842." The principal difference between this arm and No. 2 is in the catch. Improvement questionable.

These three types were made from 1833 to 1843, and each is believed to be one of the first of its type issued, so that its date is the type date. After 1843 all of these flint lock arms, when found stored in considerable quantity, were altered to cap lock.

No. 4, Hall. 4th type. Made between 1843 and 1852 at the S. North factory, and made percussion. The side lever was the joint device of Simeon North and Edward Savage; it was adopted by the Ordnance Department in 1843 and patented in 1844. The length of this arm is 40 inches; length of barrel 21 inches; the calibre still is .54.

No. 5, Paterson Colt. 1836 to 1842. Marked "Patent Arms Mfg. Co., Paterson, N. J." Samuel Colt's patent of 1836. A gun size revolver. Calibre .54, six shots, paper cartridge or loose ammunition.

No. 6, Paterson Colt. 1836 to 1842. Same patent and make as No. 5, but simpler and stronger.

As all early Colt arms are fully treated in Vol-

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ume 2 of *Firearms in American History*, unnecessary repetition is omitted.

No. 7, Whittier. 1837. Patented in 1837 by O. W. Whittier of Enfield, N. H. The cylinder was revolved by a stud sliding in grooves in the periphery of the cylinder. Movement of the ringed lever underneath the frame cocked and revolved. This means of operating a revolving cylinder remained in disuse for about 60 years and then was taken on by foreign inventors, and satisfactory revolvers on this principle of German, Belgian, French and British manufacture have been on the market for a score of years.

No. 8, Jenks. 1838. Wm. Jenks patent of 1838. Marked " N. P. Ames Arms Co., Springfield, Mass." Calibre .54. The specimen shown was made in 1847 and has a Maynard priming magazine in the lock; the earlier ones were without the priming magazine. Paper cartridge or loose ammunition. The hammer is cocked by a horizontal movement to the right. The load is inserted at the breech through an opening revealed by drawing back the top lever. While intended only for navy use, during the Civil War it was issued to cavalry also.

No. 9, Musketoon, Model 1842. This cavalry arm was made in small numbers between 1842 and 1855 at the Springfield Armory. Calibre .69. The charge was 60 grains of coarse powder and, originally, a spherical bullet .64 inch in diameter; towards the

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end of its issue a Minié bullet was used. The mountings are brass. The most interesting feature is the sliding stud and chain to prevent loss of the ramrod, unless it may be the huge sabre bayonet.

Plate 32

No. 1, Deringer. 1843. Marked "H. Deringer, Phila., 1843, U. S." Breech loading; paper cartridge or loose ammunition; self priming; double set trigger. This arm is so odd that the purpose of some of the holes is not now apparent. Its general operating principle and also its appearance coincide remarkably with those of the Merrill-Thomas-Latrobe carbine of about Civil War time.

No. 2, Sharps, about 1848. Breech loading, paper cartridge or loose ammunition, and provided with a ramrod for muzzle loading. Christian Sharps arms, patented in 1848, are claimed to have been made several years earlier. The specimen shown is marked "Maynard Gun Co., Chicopee Falls, Mass.," and has the 1845 style of Maynard priming magazine.

No. 3, Colt, Model 1848. Details already published in Volume 2.

No. 4, Colt, Model 1851. While primarily intended for the navy, large numbers were issued to cavalry. Details already published.

No picture. Harpers Ferry Pistol Carbine Model 1851. Data lacking.

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No. 5, Maynard, 1851. Patented in 1851 and again in 1859 by Edward Maynard. Metallic cartridge with small hole in the center of the head to admit the flash of a copper cap on a cone set in the frame. Marked "Massachusetts Arms Co., Chicopee Falls, Mass." Calibre .50.

No. 6, Lawrence, 1852. Richard S. Lawrence's patent of 1852. Breech loading, paper cartridge, calibre .52. Marked " R. S. Lawrence, Hartford, Conn."

No. 7, Greene, 1854. Breech loading, paper cartridge, calibre .53. The action of the forward trigger permits the barrel, which is held in a short sleeve, to be revolved a quarter turn to one side, during which movement the lugs on each side of the rear end of the barrel become disengaged from the corresponding grooves in the fore part of the frame. The barrel can then be slid forward and the sleeve and barrel revolved to the right on an axis below the barrel so that the paper cartridge can be inserted. When the barrel is again in place the base of the cartridge has been penetrated by a prolongation of the tube conducting the fire from the cone.

No. 8, Smith & Wesson. 1854. H. Smith and D. B. Wesson's patent of 1854. An early and rather crude specimen is illustrated. Like the repeating pistol of contemporary and later issue it uses a hollow bullet fired by an explosive mixture within itself; the base of the bullet was sealed with

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PLATE 32

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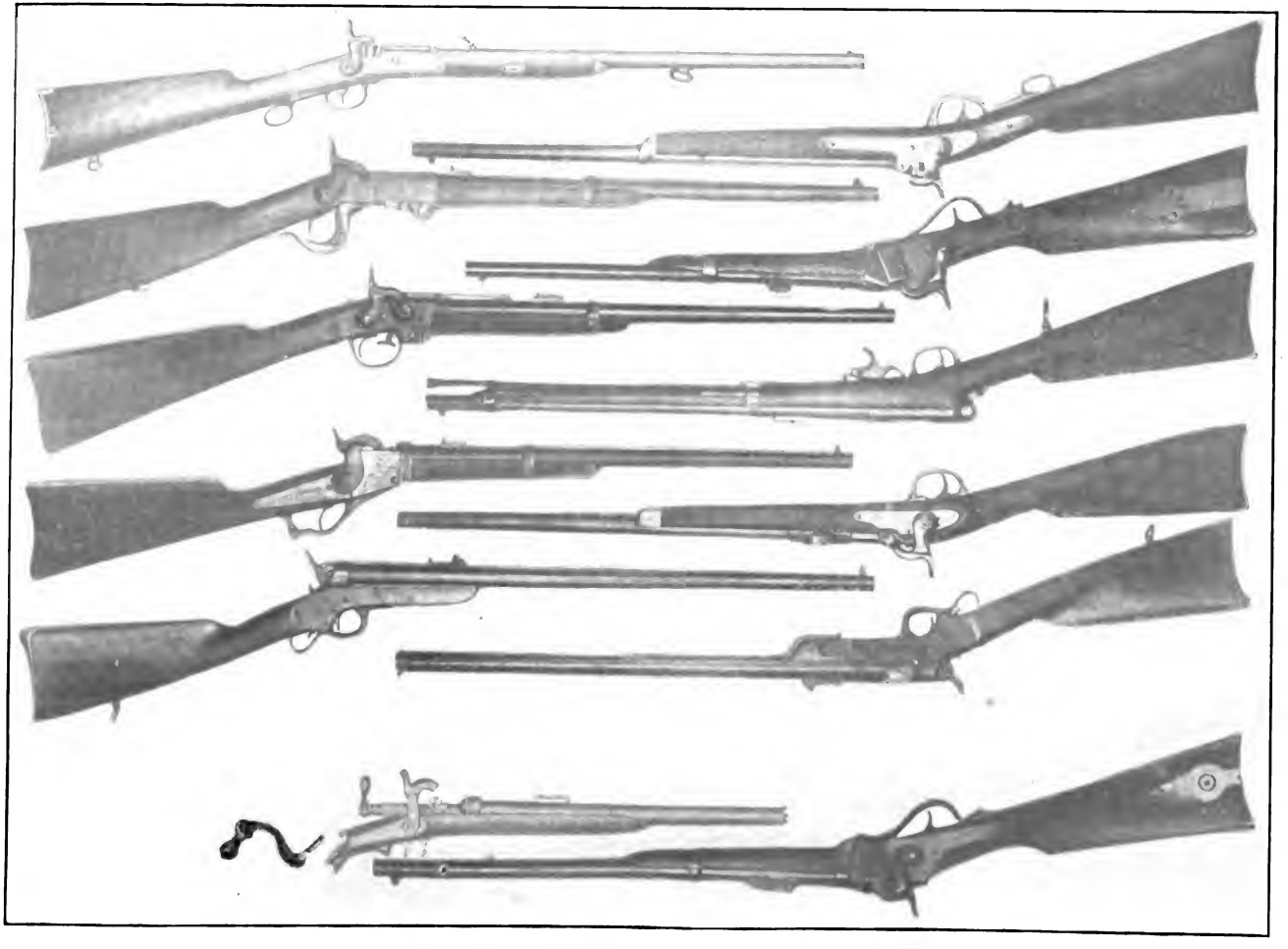

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a metal disc like a washer with a hole in the center occupied by a percussion cap. The bullets were carried in a magazine below the barrel and fed by a simple mechanism actuated by swinging the trigger guard for a lever.

No. 9, Springfield Model 1854. Marked "Springfield 1854 U. S." Muzzle loading, calibre .54. Brass fore end tip, otherwise iron mounted. Ramrod attached to the barrel by a swivel.

No. 10, Pistol Carbine Model 1855. Marked "Springfield 1855 U. S." Calibre .58. Muzzle loading. Detachable butt-stock. Weight with stock about 5 pounds. Issued to cavalry and dragoons. Good for the latter and not for the former.

No. 11, Colt Perfected Model 1855. Details already published in Volume 2.

No. 12, Joslyn. 1855. B. F. Joslyn's patent of 1855. Breech loading. Paper cartridge. Brass frame and butt plate. Marked "B. F. Joslyn Fire-arms Co., Stonington, Conn."

PLATE 33

No. 1, Perry. 1855. Marked "Perry Patent Arms Co., Newark, N. J." Alonzo D. Perry's patent of 1855. Breech loading, paper cartridge or loose ammunition. Breech block, hung like a cart-wheel, swings up by leverage of the trigger guard.

No. 2, Gibbs. 1856. Marked "Wm. F. Brooks, New York, 1863." Breech loading. Paper car-

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tridge. Calibre .52. Barrel slides forward and rear tilts up.

No. 3, Burnside. 1856. General A. F. Burnside's patent of 1856. Breech loading. Calibre .54, using a peculiarly formed conical brass cartridge exploded through a perforation in its base by a copper cap on a cone in the block. The breech block in closing has a forward movement, jamming the front of the cartridge into the barrel; the brass shell therefore covers the joint. While this feature was good, the extraction of the empty shell often gave trouble. Marked " Burnside Rifle Co., Providence, R. I."

No. 4, Sharps, 1856. Made from 1856 to 1859. Breech loading. Paper cartridge or loose ammunition. Calibre .52. Equipped with the 1855 pattern of Maynard priming magazine. Marked " Sharps Rifle Co., Hartford, Conn."

No. 5, Smith. 1856. Gilbert Smith's patent of 1856. Breech loading, using at first a rubber-covered cartridge. Calibre .52. Marked " American Arms Co., Chicopee Falls, Mass." By means of a lifter in front of the trigger a long spring on top of the barrel could be raised, unfastening the barrel from the breech and permitting the barrel to tip down on a hinge.

No. 6, Greene. 1857. Colonel J. D. Greene's patent of 1857. Calibre .56. Marked " Millbury, Mass." No change, but size, from the Greene rifle.

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No. 7, Starr. 1858. E. T. Starr's patent of 1858. Calibre .54. Marked "Starr Arms Co., Yonkers, N. Y." While in appearance similar to the Sharps, the mechanism is unlike, as the breech block swings down backwards.

No. 8, Lindner. 1859. Edward Lindner's patent of 1859. Breech loading. Paper cartridge. Calibre .58. By means of the bolt on top of the barrel and extending to the right the movable breech block can be turned to the left to expose an opening.

No. 9, Sharps & Hankins, 1859. Army. Christian Sharps' patent of 1859. Breech loading. Rim fire copper cartridge, calibre .56. Marked "Sharps & Hankins, Philadelphia, Pa." By swinging the trigger guard forward the barrel slides ahead for loading.

No. 10, Sharps & Hankins. 1859. Navy. The barrel has a leather cover, sewed on, and the thickness of the cover is met at the muzzle by a metal ring. Otherwise similar to the army pattern.

No picture. Symmes. About 1859? Breech loading. Paper cartridge, calibre .54. The breech block rotates upward, by lever movement, around an axis at its rear, bringing the hole through the block in line with the bore for the insertion of a cartridge. Bore is pentagonal. Lock has priming magazine similar to the Maynard.

No. 12, Bethel-Burton. 1859. Breech loading. Paper cartridge. Calibre .52. Bolt action, with

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a sleeve on the bolt containing a nipple to take a copper cap; sleeve and nipple move back with the bolt. The rear of the bolt has an interrupted screw with which to lock the bolt in its forward position.

No. 13, Sharps. 1859. The main difference between this Sharps and its predecessors lies in the priming magazine, the joint invention of Mr. Sharps and R. S. Lawrence. By removing a screw at the bottom of the lock plate a brass tube of waterproof priming discs can be inserted; these, by the movement of the hammer, are fed forward one at a time to the cone. The device is the same one employed in the Butterfield revolver, with which all students of arms mechanisms are familiar. The carbine shown has another noteworthy feature, which, however, is entirely aside from anything to do with Sharps patents, and that is the coffee mill in the butt. This device was invented by a workman in the government arsenal at St. Louis during the Civil War. Several models of Sharps carbines were altered in this way, the idea being to furnish one such carbine to each cavalry company. The detachable handle is shown by 13A.

Plate 34

No. 1, Merrill-Latrobe-Thomas. About 1859? This arm and the Deringer shown on Plate 31, No. 1, are remarkably similar, barring the construction of the lock and the 1855 priming magazine on this one. Breech loading. Paper cartridge, calibre .58. Made by Remington. Throwing forward the top lever

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PLATE 34

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rotates a cylindrical shaft which is perpendicular to the axis of the bore, and brings an opening in the shaft in line with the bore. The paper cartridge is then pushed into place by a piston worked by hand against the action of a spring which withdraws the piston.

No. 2, Wesson. 1859. Frank Wesson's patent. Breech loading. Rim fire copper cartridges. The barrel is pivoted, underneath, at the forward part of the fore end so as to tip up at the breech. The early specimens had different devices for releasing the barrel, the most common of which was a stud at the left side of the frame. The empty shell was withdrawn by the fingers, no mechanical means being provided; generally a ramrod became necessary to drive the shell out.

No. 3, Wesson. 1862. This improved Frank Wesson carbine had a different barrel releasing method; trigger action instead of stud action. The amount the barrel could tip up was limited by a stud on the side of the barrel moving in a slotted loop projecting up from the frame. A hand operated extractor was provided. Marks, " Frank Wesson, Worcester, Mass." Uses the same cartridge as No. 2, a .44 rim fire.

No. 4, Gallager. 1860. Mahlon J. Gallager's patent of 1860. Marks, " Richardson & Overman Arms Co., Philadelphia, Pa." Breech loading. Paper cartridge, calibre .54. Swinging the trigger guard forward moves the barrel forward.

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No. 5, Spencer. 1860. Christopher M. Spencer's patent of 1860. Seven shot repeater. Magazine in butt. Metallic cartridges, rim fire, .56 calibre. This was one of the most important carbines of the Civil War.

No. 6, Henry. 1860. Tyler Henry's patent of 1860. Fifteen shot repeater. Magazine under barrel. Used .44 calibre rim fire copper cartridges, containing half ounce conical bullet and .30 grains of powder. Marks "New Haven Arms Co., New Haven, Conn." The best carbine of the Civil War.

No. 7, Allen & Wheelock. 1860. Ethan Allen's patent of 1860. Marks "Allen & Wheelock, Worcester, Mass." Single shot. Rim fire copper cartridge, calibre .44. The breech block is lowered by swinging the trigger guard forward.

No. 8, Colt, Model 1860. The specimen picked for illustration has a hollow butt to be used as a canteen; the orifice is at the comb of the butt and is closed by a screw stopper. Details already published in Volume 2.

No. 9, Enfield. Made in England at the government factory in Enfield and purchased by our government for use in the Civil War. Muzzle loading, calibre .577. The specimen shown is dated 1861; other similar specimens bear dates from 1855 to 1864; some of them have the ramrod free, some have it attached by a swivel, and some have the forestock running almost to the muzzle. In the Civil War

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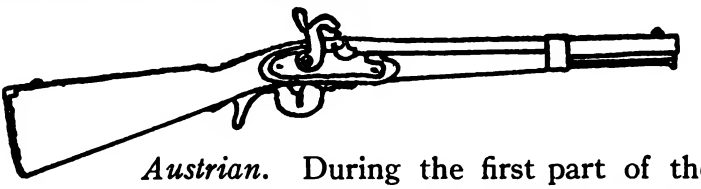
both the North and the South used Enfields. The charge was 55 grains of powder with a 530 grain hollow base pointed bullet.

No. 10, Merrill. 1861. Embodying J. H. Merrill's various patents, this specimen including the 1861 patent. Breech loading. Paper cartridge. Calibre .54. The lever above the breech of the barrel and extending forward (shown partly raised) when swung backwards withdraws a plunger from the barrel.

No. 11, Ballard. 1861. C. H. Ballard's patent of 1861. Uses a .56 calibre rim fire cartridge. Marked " Ballard Arms Co., Fall River, Mass."

No. 12, Remington-Rider. 1861. Joseph Rider's patent of 1861. Uses a .50 calibre rim fire cartridge. Marked " Remington, Ilion, N. Y." Patent purchased by the Remingtons and Rider taken into their employ. The system, after development, became the famous Remington System. At this early stage the breech block, instead of being solid as later, is split, and the hammer strikes through the opening. Also the bearings of the breech block in this early specimen are not so strong.



Austrian. During the first part of the Civil War the United States purchased a great quantity of these arms, and before their worthless-

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ness became apparent a considerable number was issued. The calibre of most of them was .75; the rifling was very deep; the recoil and the trajectory were abnormal, and accuracy of shooting was conspicuous by absence.

PLATE 35

No. 1, Lee. 1861. Marked "Lee Fire Arms Co., Milwaukee, Wis." Patented in 1862 (and reputed to have been in use a year earlier) by J. Lee, Stevens Point, Wis. Barrel swings sideways. This is probably the only Civil War carbine made in the West.

No. 2, Sharps. 1861. Sharps' patents of 1861 covered the small details of adapting his mechanism to handle metallic ammunition. The Lawrence priming magazine was of course omitted from Sharps arms using metallic cartridges.

No. 3, Howard. 1865. C. Howard's patents of 1862 and 1865. Marked "Whitneyville." Others were made by G. P. Foster, Taunton, Mass. Single shot. Calibre .44 rim fire. The orifice for loading, exposed by swinging the trigger guard forward, is underneath the barrel. This carbine, like many another, is merely a sporting arm adapted to a horseman's use by means of sling attachments.

No. 4, Cosmopolitan. 1862. E. Gwyn & A. C. Campbell's patent of 1862. Marked "Gwyn & Campbell, Hamilton, Ohio." Called also Union, and Grapevine. Breech loading. Paper cartridge. Calibre .50.

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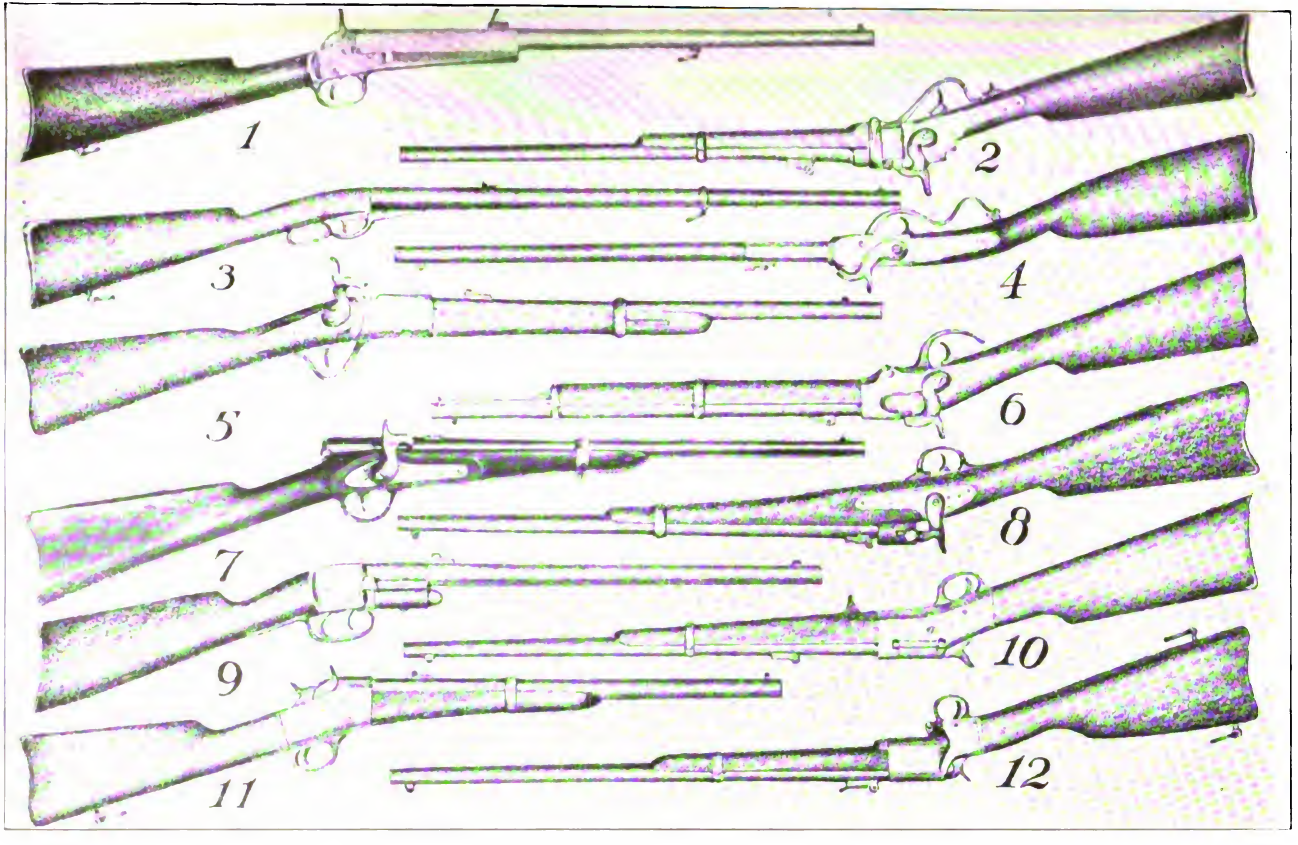

PLATE 35

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No. 5, Peabody. 1862. Henry O. Peabody's patent of 1862. The first few were made with internal hammer. Metallic cartridge, single shot, rim fire, calibre .50. Marked " Providence Tool Co."

No. 6, Ball. 1863. Albert Ball's patent of 1863. Repeater, with magazine under barrel. Calibre .56, center fire metallic cartridge. Marked " E. G. Lamson Arms Co., Windsor, Vt."

No. 7, Palmer. 1863. Wm. Palmer's patent of 1863. Single shot. Rim fire, 56 calibre cartridge. Marked " E. G. Lamson Arms Co., Windsor, Vt." Bolt action, fastening at rear with a sectional screw.

No. 8, Joslyn. 1863. B. F. Joslyn's patent of 1863. Marked " Joslyn Fire Arms Co., Stonington, Conn. 1864." Single shot. Rim fire, .56 calibre cartridge. The breech block swings over to the left.

No. 9, Rowe. 1864. A. H. Rowe's patent of 1864. Proved an infringement on R. S. Lawrence's patent of 1852. Single shot. Paper cartridge. Calibre .52. The barrel rotates to the right by pressure upon the forward trigger.

No. 10, Warner. 1864. James Warner's patent of 1864. Marked " James Warner, Springfield, Mass." Single shot. Rim fire cartridge, calibre .50. Breech block swings to right. Extractor operated by drawing upon the projection beneath the barrel; not a successful method of extracting, because hand power was insufficient.

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No. 11, Remington. 1864. The 1864 patent perfected the Joseph Rider invention described under No. 12, Plate 33. The breech action thus became the acme of simplicity and strength, and was used for the military arms of many nations.

No. 12, Triplett & Scott. 1864. Louis Triplett's patent of 1864. Repeater. Rim fire cartridge, calibre .50. Loads at the projection of the frame in front of the trigger guard. Barrel revolves on axis parallel to itself until it opens the magazine and loads. Extractor is operated by the same movement. Marked " Meriden Mfg. Co., Meriden, Conn."

Plate 36

No. 1, Winchester Model 1866. This is the first Winchester carbine. The mechanism is practically the same as that of the Henry rifle; the closed magazine loading through a gate in the frame is the principal difference. This arm has a 20-inch round barrel. The magazine holds 12 cartridges. Calibre .44 rim fire. The load was 27 grains of powder and a 200-grain flat nose bullet.

Some of the early Winchesters are represented in pictures with the opening or gate to the magazine in the left side of the frame, and, just behind it, a ring with which to attach the arm to the belt or to the saddle of the trooper. Question as to whether the picture was right or reversed.

No. 2, Evans. 1869–1871. Warren R. Evans' patent of '69 and '71. Marked " Evans Repeating

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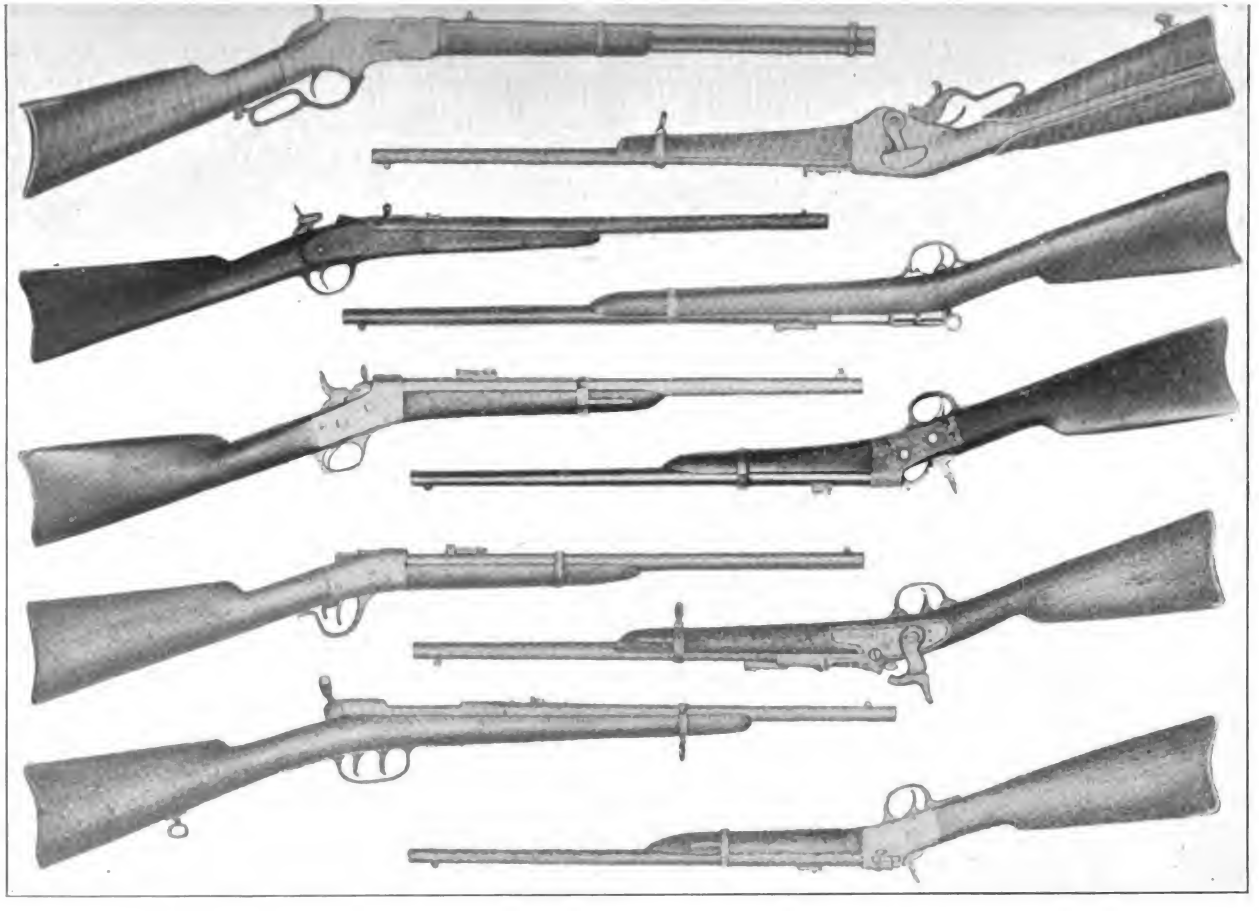

PLATE 36

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Rifle Co., Mechanic Falls, Me." Calibre .44, rim fire. The butt stock is built on a steel tube, which is a magazine holding 32 cartridges (some held 26), fed to the barrel by the screw-feed principle. The cartridges were introduced through the butt plate one at a time, and the breech mechanism had to be operated for each one to send it ahead. Charging the magazine being therefore a lengthy operation, the arm failed to attain popularity.

No picture. Experimental Springfield Model 1868 Pistol-carbine. Abandoned.

No. 3, Van Choate. 1870. S. F. Van Choate's patent of 1870. Bolt action. Rim fire cartridge, calibre .50. The most interesting features are positive retraction of the firing pin caused by the contact of its head with the tip of the recoil screw, and the ejection of the empty shell by a blow which swings it around the hook of the extractor and out of the gun.

No. 4, Ward-Burton. 1870. Marked "Springfield, U. S." The Ward Burton system was laid before the Board of 1870, accepted for trial in the field, and a few of the carbines were made at the government armory. Calibre .50, center fire. Single shot. The bolt closes against the cartridge and is held in place by screw threads on its rear which engage with fixed threads in the receiver.

No. 5, Remington. 1870. Laid before the Board of 1870, accepted for trial in the field, and a few made and issued. Calibre .50.

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No. 6, Remington .45. In all but calibre this arm is substantially the same as No. 5. It was adopted by the New York State Militia.

No. 7, Sharps-Borchardt. 1870. Laid before the Board of 1870, accepted for trial in the field, and a few made and issued.

No picture. Whitney. 1870. Except for the fact that the frame is brass this arm in appearance so closely resembles the Remington that no difference would be noticeable on the exterior. In mechanism the funda ental principles are the same; some slight differences in form, and in the way the breech block is backed up by the hammer, enabled its designer, Captain Laidley, to obtain a patent. Refused by the Ordnance Board.

No. 8, Springfield Model 1870. Allin System, calibre .50, center fire. Marked " Springfield, U. S., Model 1870." When new all metal was polished bright.

No. 9, Brown. 1871. Single shot. Calibre .50, center fire. Bolt action. Trigger cocking. Marked " Brown Mfg. Co., Newburyport, Mass." Refused by the Ordnance Board.

No. 10, Phoenix. 1872–74. Single shot. Calibre .44, rim fire. Made by E. Whitney, Whitneyville, Conn. The claim for this carbine was that it had the fewest parts of any breech loading rifle of its time. To load, the hinged breech block was swung

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to the right; then drawn rearward to extract. Used by militia.

No picture.. Ward-Burton Repeater. 1872. Similar in appearance to the Ward-Burton single shot except for a magazine beneath the barrel. The magazine was charged from below by drawing back the bolt, which raised the carrier and exposed the opening into the magazine. Refused by the Board of 1872.

Refer to No. 8. Springfield Model 1873. In a small scale illustration there is little difference in appearance between Model '73 and Model '70. The constructional differences are as follows: — cartridge, 45–70–405; steel instead of iron barrel; lock plate thinner and without beveled edge; hammer and screw heads rounded; rear swivel held by screw instead of rivet; changed shape of forward swivel and of band; stacking swivel added; rear sight changed and set further forward; metal parts all finished dark; stock rounded adjoining lock plate and on upper edge as far as band.

Refer to No. 8. Springfield Model 1877. No radical change in appearance from the Model 1870. The lock has a three-click tumbler. The sight is slightly different. A wiping rod in pieces to be screwed together is held in a recess in the butt, reached through a trap door in the butt plate.

Plate 37

No. 1, Hotchkiss. 1878. This is the repeater developed from the single shot bolt action arm

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patented in 1875 by B. B. Hotchkiss, and made, this and the later ones also, by the Winchester Co. It used the service .45 calibre ammunition. It was a good arm, having as its principal defect the slow loading of the magazine. It was considerably used by United States troops.

In 1879 two Ordnance officers offered their Russell-Livermore design for loading and carrying cartridges in a different way; their plan was to drop the ammunition into a well opening from the comb of the stock. Refused.

No. 2, Hotchkiss. 1882. This pattern differs from the 1878 one in having both the cut-off and the safety set inside the wood. Both this arm and its predecessor have sectional cleaning rods contained in their fore-ends, reached through the fore end tip.

No. 3, Hotchkiss. 1883. In this, the most developed type, a steel receiver is interposed between the butt and the fore end, and the cut-off and safety are set on the outside.

No. 4, Springfield Model 1884. The changes conformed to those in the Model 1884 rifle.

No. 5, Krag, Model 1896. This carbine is built after the Model 1892 Krag rifle and differs in the following particulars: — the barrel is 22 inches long; half stock; only one band, and that provided with a rear sight protector; no butt swivel and plate; cleaning rod in two sections and carried in the butt. Ammunition the same as for the rifle.

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No. 6, Krag, Model 1899. The changes conformed with those in the rifle Model 1898.

Since the Model 1899 no carbines have been made, the modern rifle being used by all branches of the service. In fact our Springfield rifle, only about 3 feet, 7 inches long, is shorter and handier than some of the carbines were, considered as horsemen's arms. Among foreign nations also the tendency for a score of years past has been towards a one-service arm. Of the dozen or so nations who fought with us in the World War only four still issued, officially, a special arm to its cavalry.

Carbines of Official Issue used by the Allies Who Participated in Actual Fighting in the World War

No. 7, Great Britain. Commonly called the Short Enfield. Length 3 feet, 8½ inches. Calibre .303. Barrel length 25 inches. 5 grooves, twist 1 in 10 inches. 10 shot magazine. This arm superseded the Long Enfield after 1907 until the exigencies of the World War brought the Long Enfield again into service.

No. 8, France. Berthier carbine, Model 1892. 8 mm. Weight 7¾ pounds. Box magazine holding 3 cartridges. Length of barrel 18 inches. 4 grooves having 1 turn in 21¼ inches.

No. 9, Italy. Mannlicher-Carcano. 1891. Calibre 6.5 mm or .256. Weight 6 pounds 14¾ ounces.

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Has bayonet, permanently fixed to it, when not in use folding rearward below.

No. 10, Rumania. Mannlicher. 1893. Calibre 6.5 mm or .256.

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Chapter IV

RIFLED CARBINES USED AGAINST THE UNITED STATES

War of 1812. None. British cavalry and mounted infantry used smooth bores.

War of 1847 with Mexico. None, except incidentally and unofficially. Mexico had no arms factories and her troops were equipped with purchased European weapons. Usually the agents of Mexico purchased in France, Belgium or England second-hand bargains. The English arms usually were obtained from the warehouses of the British India Company and the British African Company; the former were already marked with the sign of the company, the quartered heart with V. E. I. C. in the lozengers and often also the sign of the lion rampant; the latter bore the mark of the elephant and howdah. No new marks were added to indicate Mexican ownership. Occasionally arms were ordered new, and such were stamped with the Mexican arms, an eagle and snake. Practically all the arms purchased by Mexico were smooth bores. It is reasonably correct to say that any rifled arms used by Mexican regulars in the War of 1847 were either of the Kentucky rifle type captured from civilians north of the boundary, or were battlefield pick-ups.

Civil War, Confederate States. At the outbreak of war in 1861 the carbine shortage in the Confed-

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eracy was worse, if possible, than that of infantry arms, and mounted soldiers used personal property sporting weapons, mostly single and double barrel shotguns. But during the first year of the war the machinery captured at Harpers Ferry Arsenal in April, 1861, was set up at Richmond, Va., and Fayetteville, N. C., and the tons of manufactured and partly formed parts which had escaped the fire at the Ferry Arsenal were made into complete guns. At the same time agents in Europe were buying foreign arms and agents at home were assisting and contracting with manufacturers within the Confederacy to repair and remodel on a large scale both sporting arms and battlefield pick-ups, and also to make military new ones.

At the present day Confederate rifled carbines are interesting as makeshift weapons to show what can be done by a highly civilized combatant lacking gunmakers, machinery and steel. Under the stress of hurry no valuable new designs were produced, but on the contrary gunsmiths who were familiar with breech loading arms made before 1861 in the North — such as Perry, Sharps, Maynard, etc., — produced reproductions modified as to simplification and as to the substitution of brass wherever it was possible in a carbine to use that easily worked metal in place of iron.

Within a few years of the close of the war nearly all the captured Confederate arms were broken up for junk, and it is probable that the few different kinds of home-made Confederate rifled arms now

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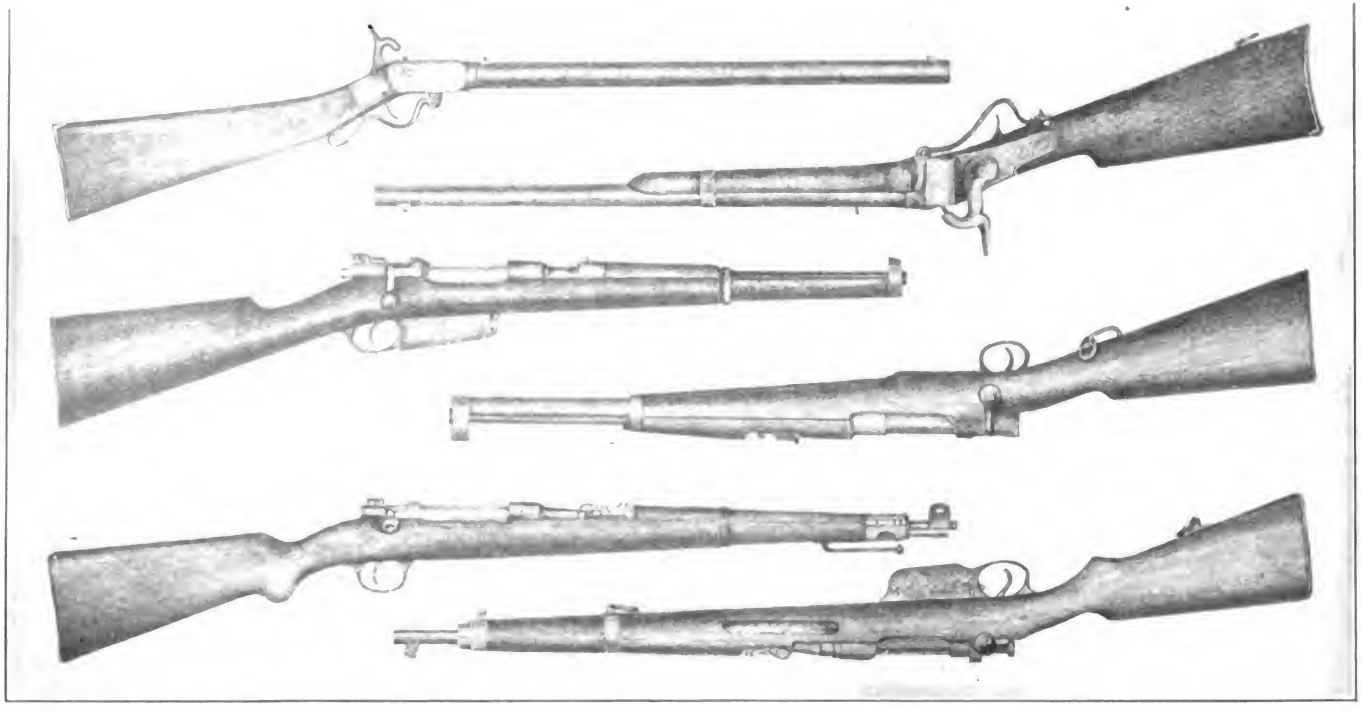

PLATE 38

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known represent but a portion of the varieties in use.

PLATE 38

No. 1, Confederate-Perry Carbine. No marks. Calibre .52. Brass breech block which turns up like that of a Perry rifle, operated by a link movement like that of a Maynard. Heavy barrel, apparently an octagonal sporting one turned cylindrical.

No. 2, Confederate-Sharps Carbine. Marked on the lock "S. E. Robinson Arms Manufacturing Company, Richmond, Va., 1862." Made without a tape priming magazine. Until the closing year of the war the Confederacy was short of the ingredients for ignition and the production of copper caps alone was a task of magnitude. Made with a block movement perpendicular to the barrel axis. Brass block, butt plate, and band. Fixed rear sight. None of the metal work was surface finished and the file marks made in forming it still show.

Besides these two Confederate adaptations doubtless there were others not now so widely known. It would be extremely gratifying to collectors of ancient arms to find specimens showing marked ingenuity.

No. 3, Spain. Mauser, Model 1893. War of 1898. 5 shots. Two calibres, 7 mm and 7.65 mm.

No. 4, Spain. Mauser, Model 1894. War of 1898. 5 shots. Two calibres, 7 mm and 7.65 mm.

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Carbines Used Against the United States in the World War

No. 5, Germany. Mauser. Calibre 7.9 mm. 5 shots. Probably this pattern of the Model 1898 illustrated was most extensively used. Germany, having given strict attention to the modifications of the Mauser for special purposes, had issued a wide variety of slight variants. As the demand for arms exceeded the supply of the latest pattern, many others, not necessarily obsolete, were drawn from the storehouses and issued for service.

No. 6, Austria. Mannlicher, Model 1890. Calibre 8 mm. Weight 7 pounds 2 ounces. Length 3 feet, 3½ inches.

Of the other two nations who were part of the fighting force called "The Central Powers," Turkey issued officially no carbine, but used the rifle for all branches of the service; and Bulgaria issued the same kind of carbine as Austria.

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Part III

PRESENT MANUFACTURERS

ADOLPH

The firearms business of Fred Adolph, of Genoa, New York, is a specialized one pertaining only to made-to-order high grade arms built to suit the taste of the individual sportsman. From this book, shotguns and pistols being eliminated, mention of only one-third of the Adolph art craft remains, but the Adolph catalogue tells the rest and is worth the cost.

The business, a comparatively new one, takes the place in America which, abroad, is held by eminent craftsmen who minister to the wants of their well-to-do gun loving sportsmen. In America, the country of machine made arms in stock patterns, Adolph arms are practically the only recourse for fastidious sportsmen with special needs in the matter of combinations of bore, fit, and ornamentation. They are made to order, to measure and to design selected, in single shot, one, two, three and four barrel arms, rifles and combinations of rifled and shot barrels. Their ornamentation is elaborate and rich, their wearing qualities excellent; they are unique and distinguished, and at present they are without competitors.

Plate 39

One of the fads of the American rifle user is the possession of a sporting rifle having the same action

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and barrel as the American military rifle and using the same sort of ammunition. As our military rifles are not made in sporting grades the alternative is to alter a military rifle.

No. 1 shows an Adolph Remodeled Springfield Rifle. In rebuilding, the following parts are discarded; stock, guard, bands, sights, and bolt stop pin. The barrel and action are then refinished and a sporting shape stock is made to measure to fit the user.

No. 2 shows the same arm with an Adolph telescope sight and mountings.

Nos. 3 and 4 are shown as samples of ornamentation on bolt action rifle guards.

Plate 40

No. 1 shows an ornamented triggerless Mauser with barrel made of the new "Anticorro" Poldi steel. This steel is practically unrustable.

As it is impracticable to attempt to show the infinite variety of special two, three and four barrel rifles, over and under, side by side, combinations of rifles and shotguns, etc., a single average specimen has been chosen as the one having the widest appeal to the man who is tired of repeaters.

No. 2 shows a double barrel, top lever action rifle taking the .30 Newton Express cartridge, which has an initial velocity of 3,200 foot seconds. The weight is about 8 pounds. Its two shots can be fired practically as one.

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PLATE 39.—Adolph Rifles

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PLATE 40.—Adolph Rifles

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COLT *

The story of Colt arms dates from 1836. From then until the close of our Civil War in 1865 its history was thoroughly covered in Volume 2.

Since 1865 its rifle work has consisted of

Double barrel .45 calibre express rifles, about a score;

Franklin magazine rifle, not carried beyond the model stage in 1881;

" Lightning " trombone action repeaters, from Elliot's patents, in appearance so closely resembling Winchester trombones as to need no pictures;

Lever action repeaters, from the series of Burgess' patents extending between 1873 and 1882, sometimes called " Colt-Winchesters " on account of the close resemblance.

The Colt Patent Firearms Manufacturing Company has issued no sporting rifles for several years.

* Samuel Colt, b. 1814; d. 1862.

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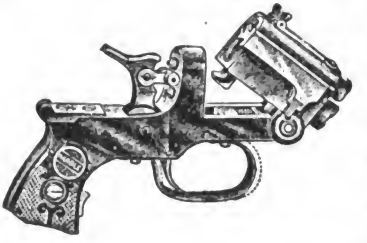
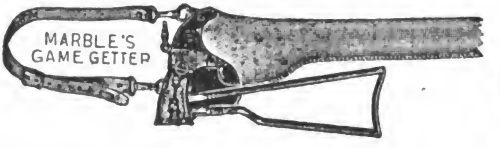
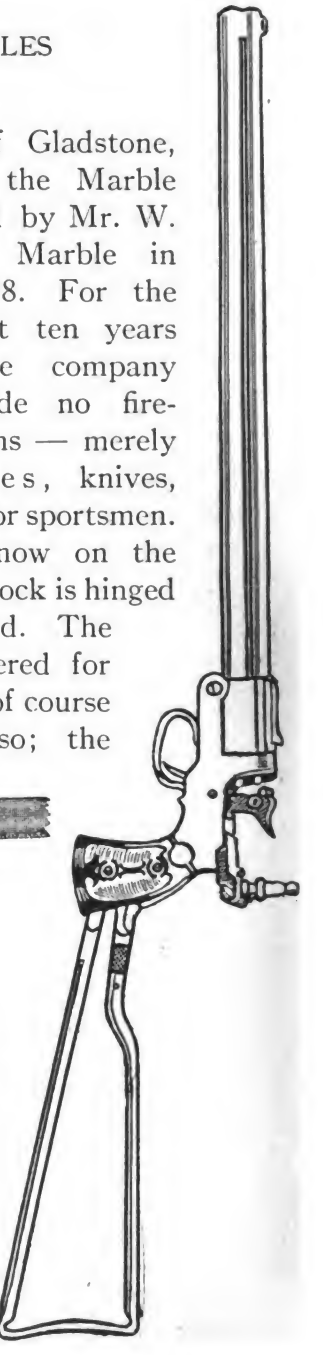
MARBLE

The Marble Arms Co., of Gladstone, Michigan, originally called the Marble Safety Axe Co., was founded by Mr. W. L. Marble in 1898. For the first ten years the company made no fire-arms — merely axes, knives, rods, etc., designed especially for sportsmen. The Game Getter Gun as now on the market is model 1908. The stock is hinged to fold, and also can be removed. The upper, rifled, barrel is chambered for .22 long rifle cartridges, and of course uses shorts and B. B.'s also; the lower barrel is chambered for .44 calibre centre fire cartridges, is not rifled and is bored a true cylinder with the object of using shot, but uses round or conical bullet for close quarters.







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Marble

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MARLIN *

Established 1870. Made revolvers and Ballard single shot sporting rifles until about 1890. Began making repeating rifles 1881.

Ballard rifles, long ago obsolete, were perhaps the most popular single shot sporting rifles of black powder ammunition days. In outline they approached more closely than any others the pleasing lines of the muzzle loaders. In breech mechanism they were both certain and strong. The breech block, which within the frame extended rearward to the support of a solid ledge, was moved rearward and downward by the forward movement of the trigger guard, unfailingly freeing and extracting the shell; and by the backward movement of the guard the breech block pressed the cartridge firmly into the chamber and supported it solidly. The light, centrally hung hammer responded instantly to the trigger; old time experts claimed that the Ballard and the Borchardt were the two fastest hammer movements ever invented. The action should be revived for use of target and small game cartridges. Ballard barrels were deeply grooved and accurately made; they gained a high reputation for non-fouling and for accuracy. Similarly made barrels were furnished in Marlin repeaters. The first Marlin repeating rifle ejected its cartridges from the top of the frame.

* Successively J. M. Marlin, 1870–1881; Marlin Firearms Co., 1881–1915; Marlin Rockwell Co., 1915–1920.

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PLATE 41

No. 1, The action part of an Offhand Model Ballard. For other Ballards see Index.

No. 2, Model 1881, the first repeater. It was made in a series of three, for 40–60–260, 45–70–405, and 45–85–285, all, in their day, considered powerful cartridges. This model was discontinued and superseded by

No. 3, Model 1889. In this model the opening for ejection of shells was changed from the top to the right side of the frame, leaving the top solid to prevent the entrance of objectionable matter. The gate in the frame, which in the model 1881 was a sliding one, now was hinged at the rear. Ammunition for this model ran from 32–20 to 44–40, and included the two very popular cartridges invented by the Marlin Co., the 32–40 and the 38–55. This model was discontinued about 1900.

No. 4, shows the newly designed side opening in the frame, thereafter used on all Marlin lever action repeaters, and also shows the catch below the frame for retaining the guard lever; an awkward device omitted from later models.

No. 5, Model 1891. This model, using .22 and .32 rim fire cartridges, had as its noteworthy feature a removable plate, or lid, on the right side of the frame, to give access to the mechanism. The thumb-screw showing above the junction of the lever permitted quick loosing and fastening. Model 1891 was soon

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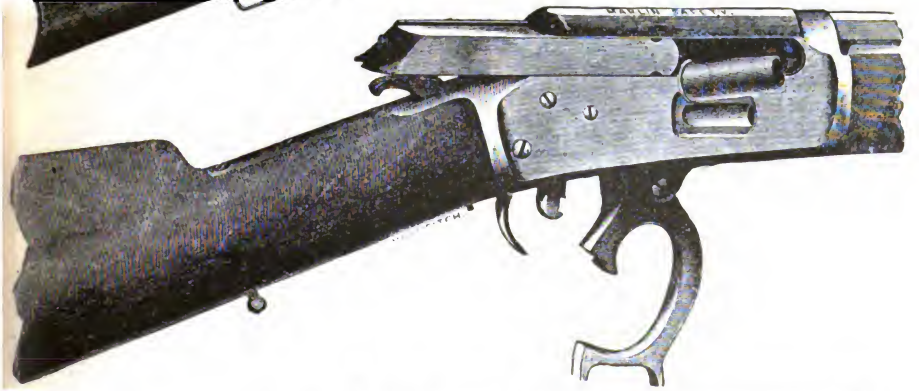

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PLATE 41.—Marlin Rifles

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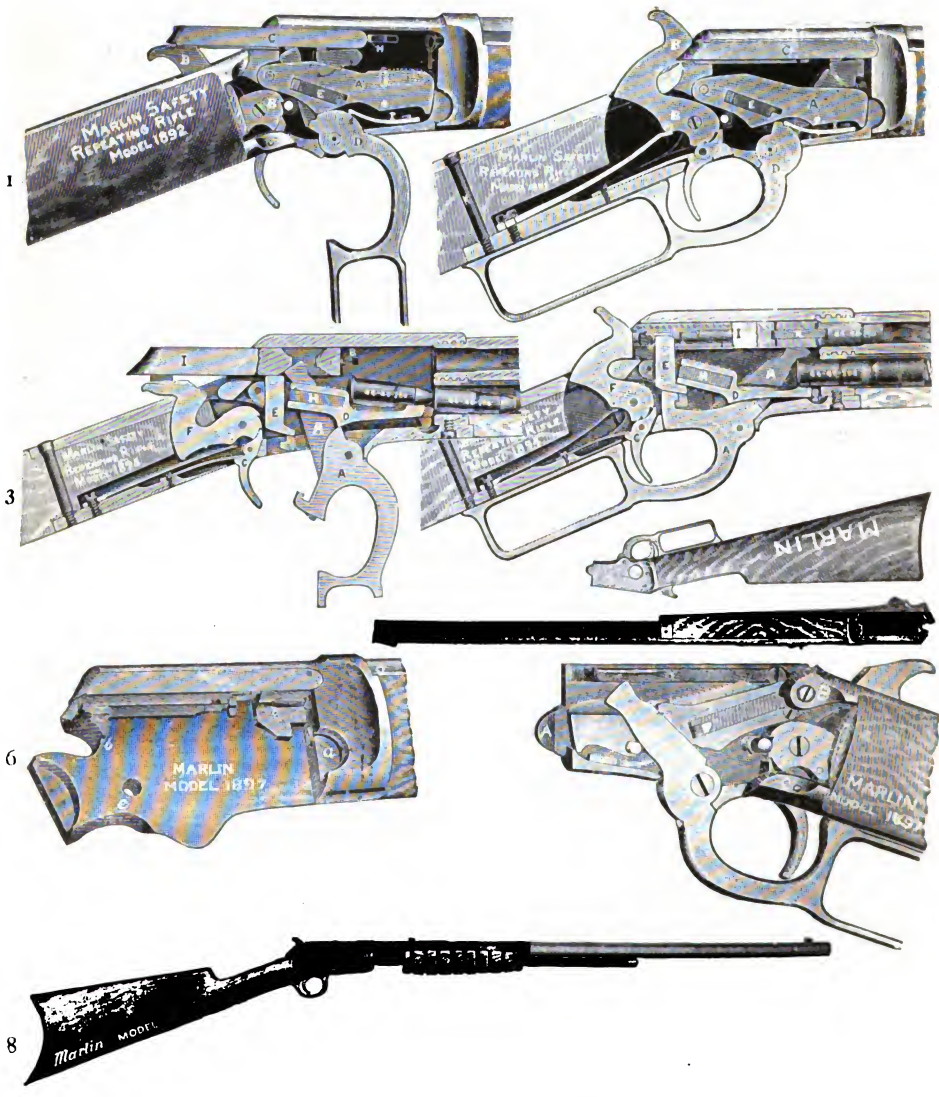

PLATE 42.—Marlin Rifles

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discontinued and was superseded by Model 1892, like it except for a few improvements simplifying the action. From this time on the external appearance of lever action Marlins remained practically the same, making pictures unnecessary. The interest centers in the slight changes in the mechanism which tended towards simplification or adapted the various arms to cartridges of varying lengths or power.

Plate 42

No. 1 shows the mechanism, open, of the Model 1892, and

No. 2 shows it closed.

No. 3 shows the mechanism, open, of Models 1893, 1894, and 1895; and

No. 4 shows the various parts in the closed position.

No. 5 Model 1897, "take down," came apart, as shown, in a manner different from its predecessors.

No. 6 and *No. 7* illustrate the method, in this arm, of securing the moving parts.

No. 8 illustrates the trombone action Marlins, a series using various calibres of cartridges. Marlin sporting arms were discontinued during the war, to permit full time to be given to air-plane machine rifles for the U. S.

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NEWTON

The Newton Arms Corporation, established in 1919, succeeded the Newton Arms Company, of Buffalo, New York, the creation in 1914 of Charles Newton, Esq., a lawyer by profession and an enthusiast upon modern arms and ammunition.

Before beginning to make rifles Mr. Newton developed ammunition, designing first the 32–40 high power cartridge, then the Savage " 22 Hi-power," then the Savage " 25-3000." These last two cartridges came on the market about 1912.

With the development of the Newton Series, — .22, .256, .30, and .35, Mr. Newton decided to enter the firearms and ammunition business. The rifles which he purposed furnishing to sportsmen who desired, in connection with small calibre, accuracy combined with extra high speed and shocking power, were to be Mausers, bored, rifled and chambered for the ammunition of his own design. The war prevented the importation of Mausers, and the Newton Rifle, of his design and manufacture, was the natural outcome.

The Newton Rifle, first issued in 1917, is a modified and improved Mauser. Its notable features are smooth outline, new take-down device, new method of releasing the bolt by trigger action, new design of set trigger, and reinforced grip to minimize accidental breakage. These features in the arm in combination with ammunition of the most up-to-date type form a combination that appeals strongly both to the big game hunter and the target shooter.

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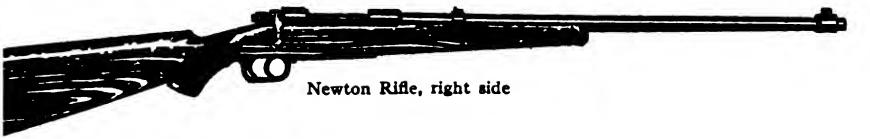
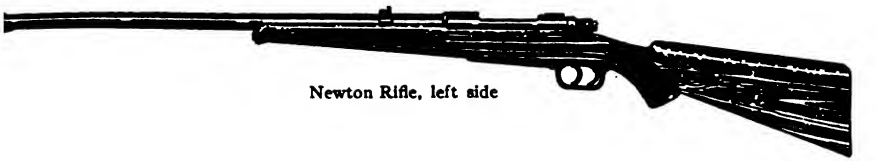
The Newton catalogue is a miniature encyclopædia of that sort of interesting and not too technical information which is helpful to the average rifleman.

During 1919 the Newton Arms Corporation succeeded the former company.



Newton Rifle, right side



Newton Rifle, left side

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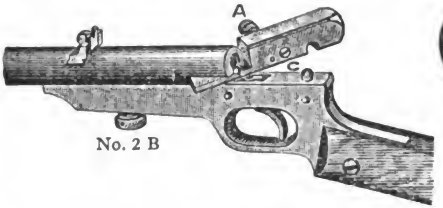
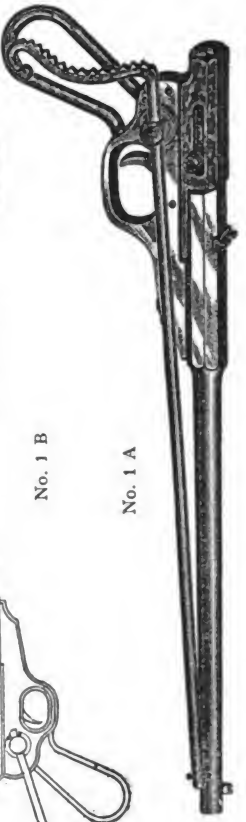
QUAKENBUSH

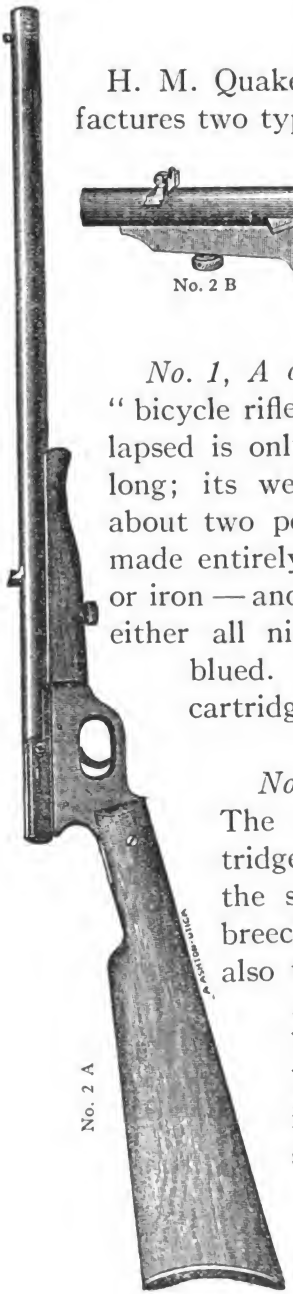
H. M. Quakenbush, Herkimer, N. Y., manufactures two types of miniature rifles.





No. 1, A and B, The "bicycle rifle" when collapsed is only 15¾ inches long; its weight is only about two pounds. It is made entirely of steel — or iron — and is furnished either all nickeled or all blued. It uses .22 cartridges only.

No. 2, A and B, The "safety cartridge rifle," has the same sort of breech device, and also uses only .22 ammunition, but differs from the bicycle rifle in having a fixed wooden stock.



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REMINGTON *

The Remington Arms Company was founded by Eliphalet Remington, 2d, in 1816. Father and son of the same name, blacksmiths, working together, and natives of Connecticut, had settled some years earlier in Ilion Gorge, New York. According to tradition it was there that the boy Eli 2d, lacking funds with which to buy a rifle, made one himself. His neighbors, seeing that it was a good gun, became customers. Blacksmithing being an intermittent business, and rifle making offering prospects of steady work, the two Remingtons added to their smithy a forge and grinding shop operated by water power from the adjacent brook. The new business grew fast.

Twelve years later the father died and left the business to Eli 2d, who promptly moved to new and larger quarters. He made a further increase to his business by beginning immediately to supply rifles and rifle parts wholesale, the latter to gunsmiths near and far, the former to stores in all towns and cities within hundreds of miles. Many a country gunsmith or town or city merchant stamped his name on the top of a barrel which bore also " E. Remington " on its under side.

About 1845 Philo Remington, son of Eliphalet 2d, became a partner, and the firm adopted the name " E. Remington & Son." During 1846 or 1847, while the Mexican War was in progress, the new firm purchased the contract between the U. S. Government

* Eliphalet Remington, 2d, born 1793; died April 12, 1861.

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and N. P. Ames & Co. of Springfield, Mass., for several thousand Jenks carbines. This contract marked the beginning of Remington business on a large scale.

In 1856 the terminal of the firm's name was changed from Son to Sons, the three sons being Philo, Samuel, and Eliphalet 3d. Prosperity was soon increased by government orders for 12,500 military rifles of Model 1841 pattern.

Eliphalet Remington 2d died in 1861, the first year of the Civil War. The firm name and business was continued by the three sons. During the four years of the war the firm produced many thousands of military rifles for the armies of the North.

In 1865 the partnership was succeeded by a corporation of the same name, which, realizing that the era of the muzzle loader had passed, voted to attempt the production of metallic cartridge breech loaders. For this end it engaged John Rider, a famous arms inventor of the time. At the Remington factory Mr. Rider developed the rolling block action backed up by the hammer which was named the "Remington System." The U. S. Navy in 1867 ordered 12,000 of these new rifles, and soon thereafter the demands of our militia and of foreign governments kept the factory running to its extreme capacity day and night. The business employed nearly 2,000 persons and soon produced a million Remington System rifles.

Meantime repeating rifles attained wide use and the popularity of single shot rifles waned. To keep

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abreast of the times the firm tried many repeating systems in rapid succession without hitting on a good one until it took up the bolt action repeater of James Paris Lee. With the Remington-Lee the firm repeated the big business that it had done with the Rider rifle, and became very wealthy.

Between the approximate dates of 1870 and 1885 the Remingtons tried a great many unproved designs in guns, rifles and pistols, making each in small quantities; more kinds, probably, than any other arms makers in existence; nearly all of these arms were commercial failures. Moreover the arms business was grafted with numerous unrelated side issues, such as the manufacture of agricultural implements, sewing machines, cotton gins, electric light machinery, typewriters, etc. In 1886 failure was the result.

The business was continued and the name kept, but control passed to Hartley & Graham, of New York. After reorganization the name became "The Remington Arms Company." Hartley & Graham thus became the controlling influence in three sorts of business, as they previously were merchants in sporting goods, and part owners of the Union Metallic Cartridge Company, of Bridgeport, Conn. Marcellus Hartley was the dominant spirit of the firm.

At the death of Marcellus Hartley, in 1902, his grandson, Marcellus Hartley Dodge, consolidated the gun and the ammunition business under the name of "The Remington-U. M. C. Co." With the outbreak of the World War in 1917, Mr. Dodge

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attempted building and operating the greatest ammunition and small arms plant in the world. To this end an enormous tract of land in Bridgeport was covered with new buildings, and contracts were made with foreign governments for the delivery at specified dates of both arms and ammunition in quantities without precedent. Unforeseen events caused failure. At present a very small portion of the enormous plant is producing sporting arms.

Pictures and descriptions of obsolete Remington rifles are scattered through the text. Those of the present day follow.

Modern Remington rifles are issued in 6 models and to each model a series, indicated in the Remington catalogue by a letter following the model number. Thus, Model 8 has in its series 5 rifles all possessing the Model 8 features but differing from each other in finish, ornamentation and price.

Plate 44

No. 1, Model 4. Single shot, calibres .22 and 25–10 Stevens, .32 long and short r.f. Has the old Remington-Rider breech action. Take down. Barrel length 22½ inches. Weight 4½ pounds.

No. 2, Model 4–S. A variant of the Model 4 called the Military Model. Made in .22 calibre only. Barrel length 28 inches. Weight 5 pounds.

No. 3, Model 6. Single shot, calibres .22 and .32 r.f. The breech action is a modification of that of Model 4. Take down. Barrel length 20 inches. Weight 3½ to 4 pounds.

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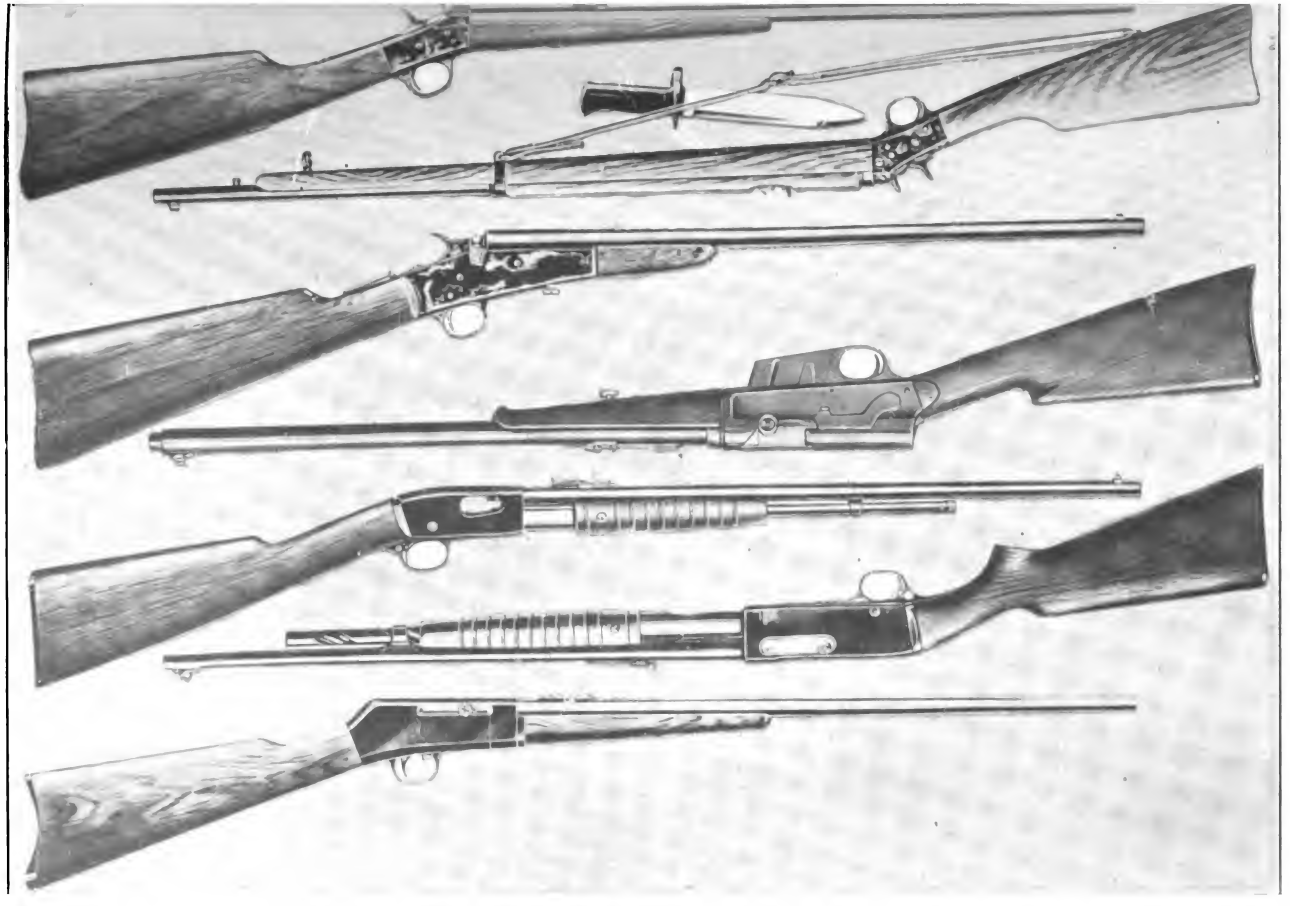

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No. 4, Model 8–A. The standard plain rifle of this series is Model 8–A. Autoloading, high power, box magazine. Uses only .25, .30, .32 and .35 Remington ammunition. The barrel, surrounded by a jacket, moves lengthwise, actuated rearward by recoil and forward by a spring; the barrel movement operates the mechanism. Take down. Barrel length 22 inches. Weight 7¾ pounds. The magazine holds 5 cartridges which can be inserted singly or all 5 in a clip.

Model 8–C
Model 8–D
Model 8–E
Model 8–F

These vary from Model 8–A, the plain, standard arm described above, in the quality of the wood, the kind and amount of the ornamentation, and the price.

No. 5, Model 12–A. The standard plain rifle of this series is Model 12–A. Trombone action .22 calibre repeater with tubular magazine below barrel. This rifle handles .22 short, .22 long and .22 long rifle cartridges. Barrel length 22 inches. Weight 4½ pounds.

Model 12–B, Gallery Special, for .22 short only. Barrel length 24. Weight 5½.

Model 12–C, Target Grade, used all 3 cartridges. Barrel length 24. Weight 5½.

Model 12–C, N. R. A. Target Grade, uses .22 l. r. only. Special sights. Barrel length 24. Weight 6.

Model 12–CS, Special Grade, uses .22 W. R. F. only. Barrel length 24. Weight 6.

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Model 12–D, Peerless Grade, uses all 3 cartridges. Fancy p.g. stock, engraved metal. Barrel length 24. Weight 5½.

Model 12–DS, like Model 12–D except that it uses .22 W. R. F. only.

Model 12–E, Expert Grade, more ornamental than Model 12–D, otherwise similar.

Model 12–ES, like Model 12–E except that it uses .22 W.R.F. only.

Model 12–F, Premier Grade more ornamental than Model 12–E, otherwise similar.

Model 12–FS, like Model 12–F, except that it uses .22 W.R.F. only.

No. 6, Model 14–A. The standard plain rifle of this series is Model 14–A. Trombone action high power repeater. Take down. Same ammunition as Model 8. Tubular magazine holding 5 cartridges. Barrel length 22 inches. Weight 6¾ pounds.

Model 14–C
Model 14–D
Model 14–E
} These vary from the standard in the quality of the wood, the kind and amount of ornamentation, and the price.

Model 14–R carbine, sling ring on left side, shotgun butt plate. Barrel length 18½ inches. Weight 6½ pounds.

Model 14½–A. Same mechanism as the Model 14 series. Ammunition .38 W.C.F. and .44 W.C.F. Magazine full length.

Model 14½ R. Carbine, generally similar to 14R.

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No. 7, Model 16–A. The standard plain rifle of this series is Model 16–A. Auto loading .22 calibre repeater. Take down. Uses only the Remington autoloading .22 cartridge. Magazine in the butt holds 15 cartridges. Barrel length 22. Weight $5\frac{3}{4}$.

Model 16–C, Special Grade
Model 16–D Peerless Grade
Model 16–F Premier Grade

} This series of 3 differs from 16–A, the standard, only in quality of wood, degree of ornamentation, and price.

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ROSS

The Ross Rifle Co., of Quebec, Canada, has for several years produced a good bolt action rifle in both sporting and military grades. The action is of the straight pull type. A rearward pull on the bolt handle causes helical ribs on the rear three inches of the bolt spindle to unscrew and release the threaded lugs from the interrupted screw threads in the walls of the receiver. There is of course merit — speed at any rate — in a straight pull; and the Ross action is much better than the old Lee Straight Pull action; the latter, however, can be redesigned to be better yet.

Ross rifles were made in only 3 calibres, .22 single shot and .28 and .303 repeaters; the repeaters hold 4 shots in the magazine and one in the barrel.

Plate 45

Shows at the top the .303 calibre sporting rifle called "Model E–10," an enlarged picture of the action, and a still larger one of the bolt. The helical ribs which turn the bolt spindle and fasten and release it are concealed from view by the outer casing. At the bottom of the plate are longitudinal section drawings of.28 calibre bullets, for which the company claims the design and declares them to have wonderful ballistic qualities, particularly the sharp pointed one. Each has a hollow nose; the left hand one has an open air space; the right hand one has embedded in its front end a sharp pointed hollow copper tube; its design would appeal, more than the design of its

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PLATE 45

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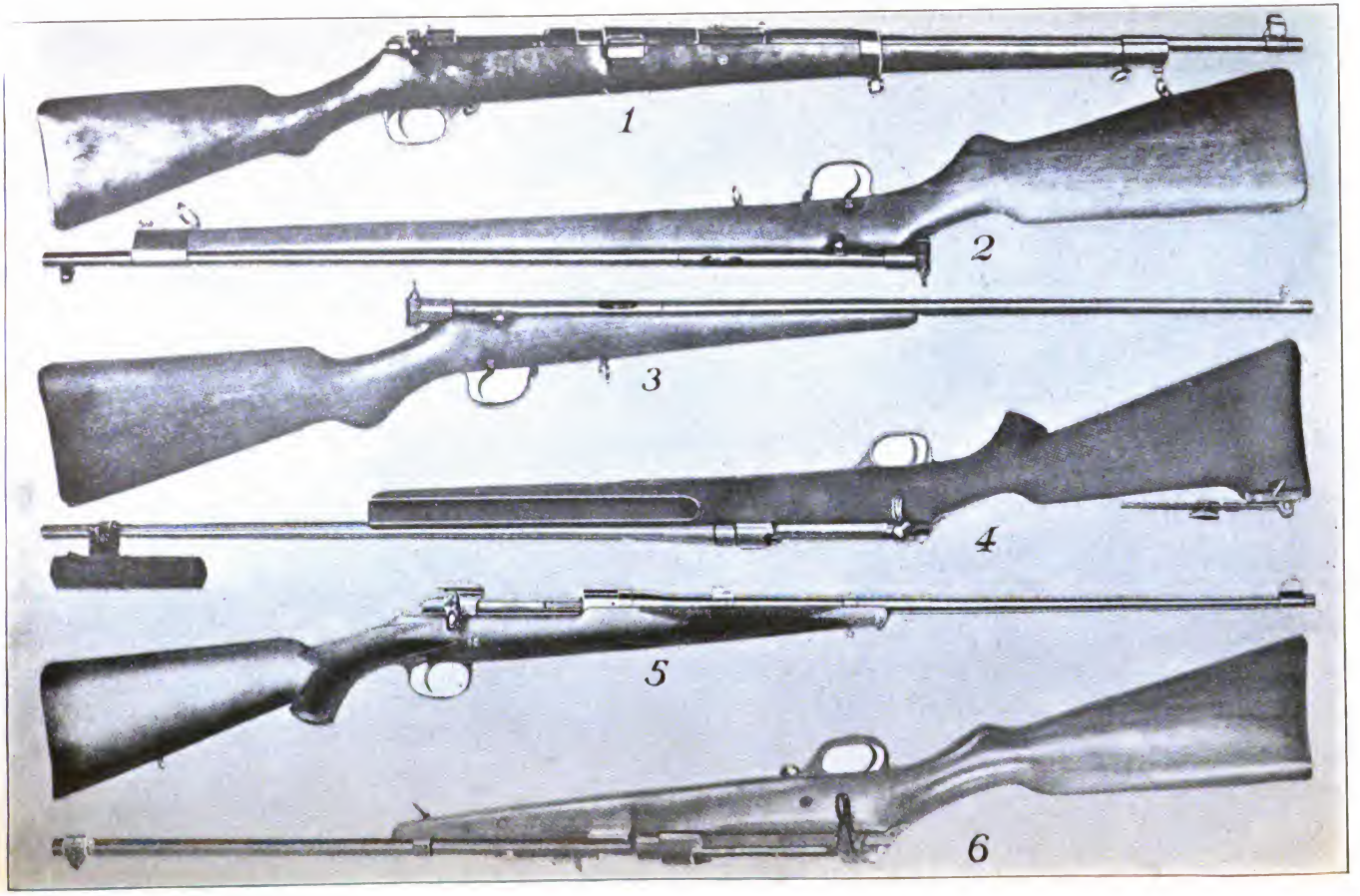

PLATE 46

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mate, to the expert rifleman. Its weight is 146 grains and its muzzle velocity 3.100 f.s.

PLATE 46

No. 1, The Military Ross, calibre .303. Canadian troops; present war service (at the beginning).

No. 2, " Cadet Type," calibre .22 L.R.

No. 3, " .22 Sporting," calibre .22 L.R.

No. 4, " Match," calibre .28.

No. 5, " M–10," calibre .28.

No. 6, " Model R," calibre .303; not such an expensive arm as " M–10."

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SAVAGE

The Savage Arms Corporation, of Utica, N. Y. was the development in 1917 of the Savage Arms Company which was organized in 1893 to manufacture a type of hammerless, solid breech, revolving box magazine rifle designed by Arthur Savage, Superintendent of the Utica Street Railway, to handle the .303 Savage cartridge. The cartridge was a smokeless powder one with a jacketed bullet; in power it was greater than the popular .30–30, and approached that of the new U. S. military cartridge. The Savage rifle appeared in the transition period between large bore with black powder and low velocity and small bore with smokeless powder and high velocity, and the combination of rifle and cartridge gained an immediate hold on public approval.

The first commercial Savage rifle was called the "Model 1895." Its external appearance has been retained to the present day, but during the first four years of its manufacture modifications occurred in the shape and position of parts of the internal mechanism which seemed to be improvements, and they were combined and adopted for succeeding issues of Savage rifles thereafter called "Model 1899." The interest in Savage repeating rifles centers in this series, shown by pictures Nos. 1 to 4 inclusive. The action is the same for all, and the differences lie in the barrel, chambering, butt, furniture and finish. There is a full-stocked military model and a short

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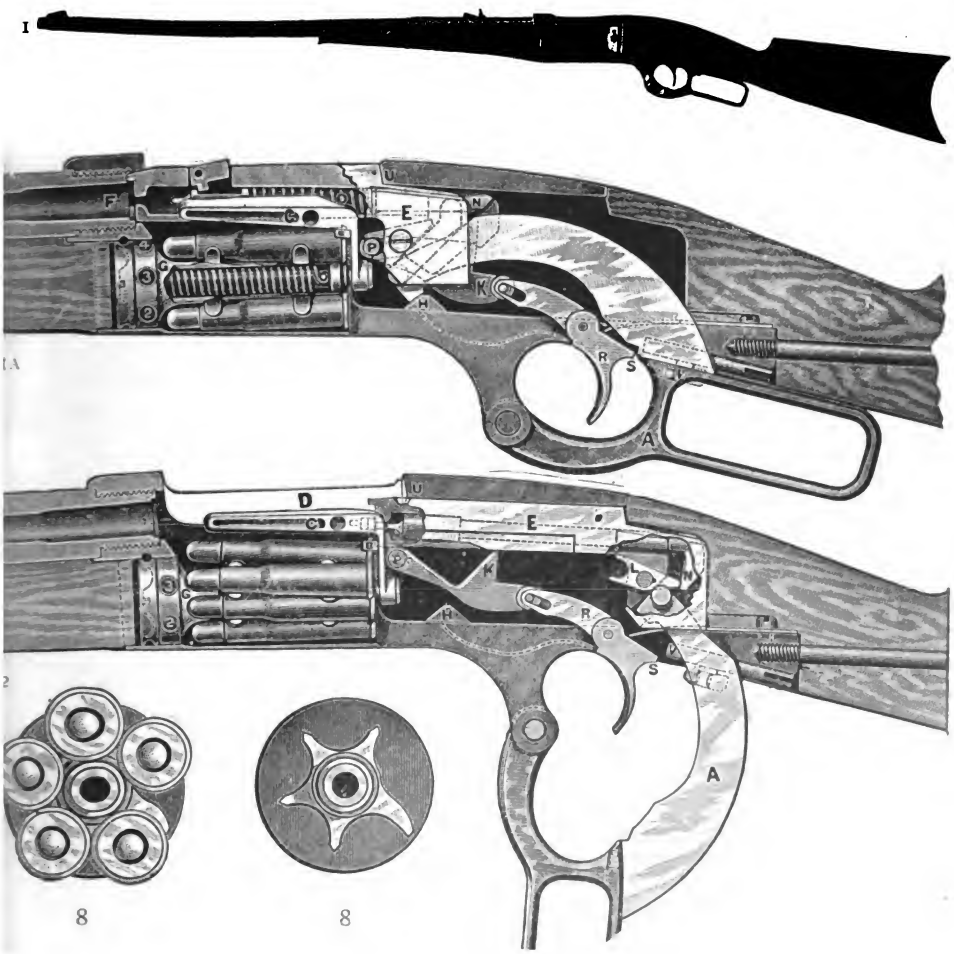

PLATE 47

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PLATE 47—Continued

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variety called carbine. Ammunition for the Model 1899 runs from .22 hi-power to .38–55 smokeless. The pictures explain the peculiarities of the interesting mechanism.

PLATE 47

No. 1, Model 1899.

No. 1 A shows the action closed.

No. 2 shows the action open.

No. 3 shows the ingenious revolving box magazine, loaded and empty, which, in essentials of design and mechanics, strongly brings to mind the ancient Roper repeating shotgun.

No. 4, Model 1903, a hammerless .22 calibre rim fire trombone action repeater, with a detachable box magazine holding 7 cartridges. Weight 5¼ pounds.

No. 5, Model 1904, a single shot bolt action rifle using .22 calibre rim fire ammunition. A boy's gun. Weight 3 pounds.

No. 6, Model 1905, the same as Model 1904 but with larger barrel and, if desired, a Swiss butt plate.

Model 1909, the same as Model 1903, but shorter and lighter. Not shown.

No. 7, Model 1911, a bolt action tubular magazine repeater for .22 short rim fire cartridges. The magazine tube, in the butt, holds 20 cartridges. Shown in longitudinal section.

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No. 8, Model 1912, an automatic box magazine repeater using .22 long rifle cartridges and weighing only 4½ pounds. Magazine holds 7 cartridges.

No. 9, Model 1914, a hammerless .22 calibre repeater with trombone action and tubular magazine holding 15 long rifle or 20 short cartridges.

No. 10, Model 1919, N. R. A. Rifle. Calibre .22, long rifle. Especially adapted for National Rifle Association competitions, it follows as closely as possible the lines, size, balance and action of the regular military rifle, and yet has a specially designed rear sight with micrometer screw adjustments for elevation and windage, with click indicators.

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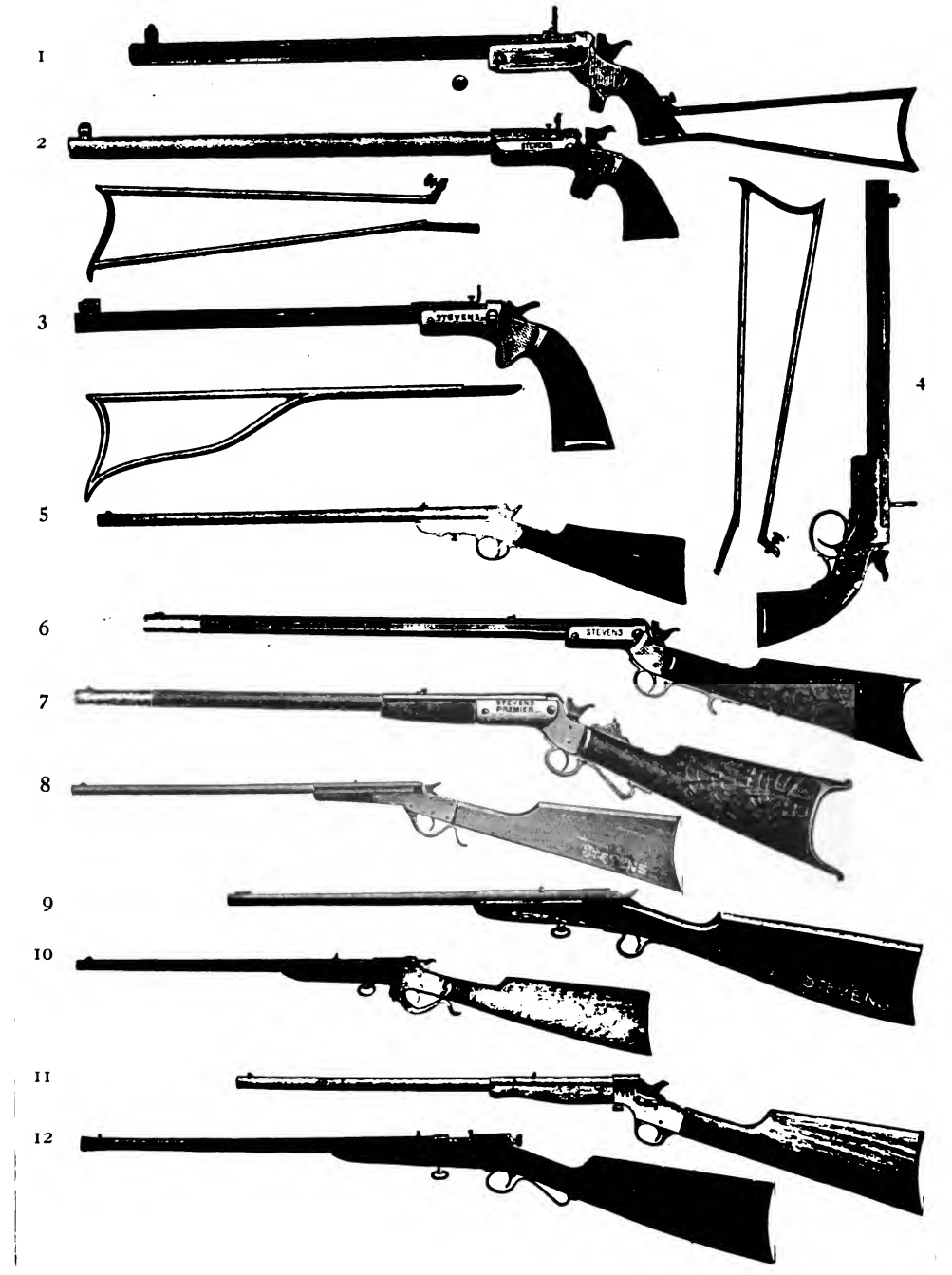

PLATE 48.—Stevens Rifles

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STEVENS *

The J. Stevens Company was started in 1864 to manufacture pistols and pocket rifles. Mr. Stevens had been employed by the Massachusetts Arms Company, particularly in connection with the Wesson & Leavitt revolver, and its successor, the Mass. Arms Co. revolver designed by him, and was an expert in the manufacture of hand firearms.

The manufacture of Stevens rifles began about 1875. In 1886 the J. Stevens Co. was incorporated under the name of the J. Stevens Arms and Tool Company, and its capacity greatly increased. Since then it has issued a great variety of hand and shoulder arms, machine made, mostly of inexpensive models, but of admirable shooting qualities.

In 1915 the plant was purchased by the New England Westinghouse Company for the purpose of producing military arms in great quantities to supply the demands of the war.

United States military rifles Model 1917, and heavy Browning Machine Rifles, were its principal output during the World War.

PLATE 48

The Pocket Rifle series.

No. 1, "Hunters' Pet." With 24-inch barrel this rifle weighed about 6½ pounds. The ammunition was .32, .38, and .44 rim and center fire. The price, which was rather high for the time, ran from $18.00 for the one with 18-inch barrel to $21.00 for the one

* Joshua Stevens.

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with 24-inch barrel; this indicates that the Hunters' Pet was intended to be accurate and serviceable. The breech of the barrel when released by pressure upon a stud in the right side of the frame tipped up to extract and be loaded. As the catch spring soon lost a portion of its strength, and as the axis screw of the barrel and the sides of the frame adjacent to it soon permitted growing looseness, the barrel after a very little use was wobbly in the frame. However, as the rear sight was fixed on the barrel, and as the barrel was heavy, accurate shooting still was possible; and the ease with which the arm could be taken apart for packing in a small space and the extreme simplicity of the make-up induced users of this type of arm to overlook its shortcomings. The weight, however, was another matter; and on account of continual criticism the Hunters' Pet was soon succeeded by lighter and also less expensive issues of the same general design. It disappeared from the market about 1888.

No. 2, "New Model Pocket Rifle." The stud for releasing the barrel catch was transferred to the left side of the frame so as to be used by the thumb. The whole arm was a diminutive, its weight with 10-inch barrel being only 2 pounds. The ammunition was .22 and .32 rim fire.

No. 3, "Reliable Pocket Rifle." This was the Diamond Model pistol with long barrel and adjustable skeleton stock.

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No. 4, New Model Pocket or Bicycle Rifle. This variant of the "Hunters' Pet" weighed but 2¾ pounds with 18-inch barrel and used .22, .25, and .32 rim fire cartridges.

No. 5, "Sure Shot." Intended especially for the use of boys and women. Used .22 and .32 rim fire cartridges. The barrel was fastened to the frame on a vertical pivot and the breech could be swung horizontally to the right to extract and load. Discontinued about 1898.

No. 6, and

No. 7. These pictures show two of a series of similar rifles, the manufacture of which began about 1875 and ceased about 1900. All were of tip-up action and used the same kind of frame; the differences lay in the butt, sights, trigger guard, and finish. Sixteen kinds were issued, each with an alluring name such as "Expert," "Premier," "Ladies," etc. Calibres were from .22 to .44, barrel lengths from 24 to 36 inches; weights from 5½ to 10¾ pounds.

No. 8, "Maynard Junior." Some of the features of the Maynard rifle were embodied in the action of this toy tip-up rifle. Discontinued about 1910.

No. 9, "Little Scout." This toy, which retailed for $1.80, is interesting only as a study of how cheaply a rifle can be made and still be safe to use.

No. 10, "Marksman." A variant on The Maynard Junior, tip-up.

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No. 11, "*Crack Shot.*" Discontinued about 1910.

No. 12, "*Little Krag.*" A fairly successful attempt at extreme simplicity and cheapness in bolt action for .22 cartridges.

The tiny rifles just mentioned were put on the market in a period when the custom was being stimulated by periodicals of permitting, or encouraging, children to learn to shoot. The rapid introduction by this company and others of so many different models was doubtless a mere business device, as it is easier to sell to a boy an arm described as "the latest thing out" than it is to sell him one such as his chum has worn out. To the mechanician and the adult arms user their only interest lies in their extreme simplicity; every last thing that could be eliminated and still have functioning and safety was discarded.

Plate 49

No. 1, "*Ideal.*" The series having the basic name "Ideal," and starting with the serial number 44, was first produced in 1894, and issued for 9 years. The mechanism was then slightly modified and called 44½ and the series continued. The cuts show the plain sporting model and its revised mechanism. This action was embodied in a wide variety of styles of barrels and stocks which were elaborated as to shape and finish; and to the old names of "Expert," and "Ladies' Model," were added such other attractive ones as "Modern Range," "Walnut Hill," "English Model," "Semi-military," "Scheutzen,"

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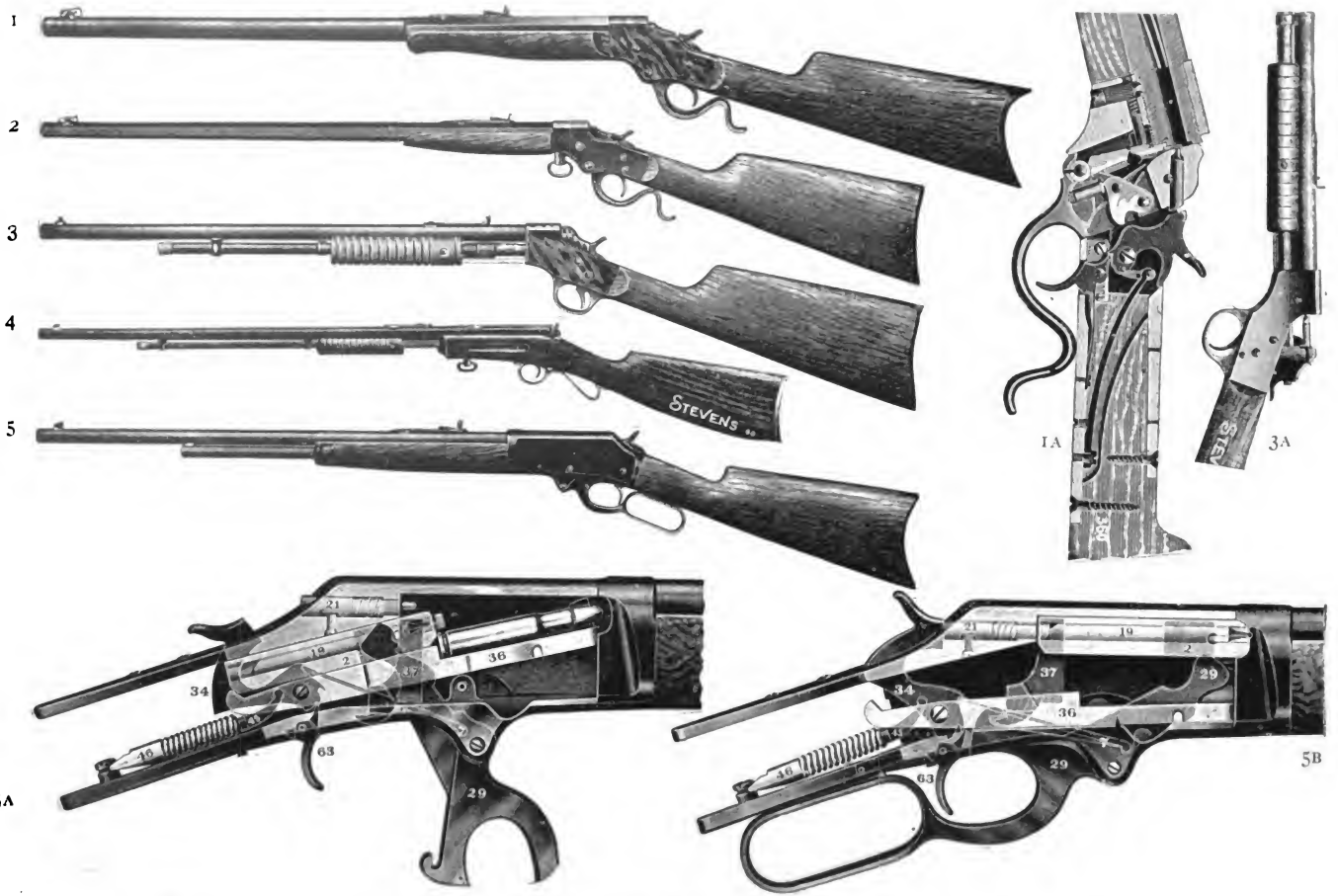

PLATE 40. Stevens Rifles.

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etc. This series held the Stevens Company's best output.

No. 2, "*Favorite.*" This series was a junior, or smaller model of the Ideal. It was put on the market at about the same time as the larger one, to use rim fire ammunition in .22, .25, and .32 calibres.

REPEATING RIFLES

No. 3, "*Visible Loader.*" Made for .22 ammunition only. Its novel feature was a magazine tube and breech block in one piece operated by the backward and forward movement of the sliding fore end.

No. 3 A shows the visible loader with a cartridge sliding up the channel in the face of the breech block and makes the mechanical features self-evident.

No. 4, "*Repeating Gallery.*" This was an attempt at a bolt action operated by a sliding fore end. Unsuccessful. Discontinued immediately.

No. 5, "*High Power.*" Made for .25, 30–30, .32, and .35 smokeless cartridges. The only feature of interest is the cocking of the hammer by leverage instead of by the thrust of the breech bolt.

No. 5 A shows the mechanism open, and

No. 5 B shows it closed.

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WINCHESTER *

The Winchester Repeating Arms Company was organized in 1866. The rifles first produced by it were the outgrowth of experiments with preceding repeating arms, and the beginning of a Winchester rifle antedated the first real Winchester by more than a decade and a half.

About 1850, Tyler Henry, an expert mechanic, was employed by Robbins & Lawrence of Windsor, Vt., to oversee the work upon the Jennings magazine gun. The Jennings rifle used hollow, loaded bullets carried in a tubular magazine below the barrel, fed to the barrel by the action of a ratchet operated by a ring trigger which had a forward and backward slide of about 3″, and fired by a Maynard Tape primer held in a priming magazine on the top of the frame. From the ideas embodied in the Jennings rifle, combined with those patented in 1851 by Horace Smith, Mr. Henry evolved another arm which used primed and loaded bullets fed from the magazine to the barrel by the movement of the trigger guard used as a lever.

This design was purchased by Messrs. Smith & Wesson, of Norwich, Conn., and modified and patented by them in 1851 and 1854; and Mr. Henry, working for them, superintended the manufacture of Smith & Wesson repeating rifles and pistols for about five years. In 1855 Messrs. Smith & Wesson, having decided to make cartridge revolvers loading at the rear of the cylinder, and desiring to give their

* Oliver F. Winchester, born 1810; died, 1880.

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whole effort to revolvers, sold the rights to their repeating arms.

The purchasers organized as the Volcanic Repeating Arms Company of New Haven, Conn. Mr. Henry was an employee of the new company. The principal owner was O. F. Winchester, of the firm of Winchester & Davis, shirt manufacturers of New Haven. The Volcanic Repeating Arms Company substituted bronze for iron, as much as possible, in their arms, and specialized on hand instead of shoulder arms. During 1855 and 1856 they accumulated a stock which far exceeded the demand, and had to reorganize.

In 1857 their goods reappeared under the name of the New Haven Arms Company. Mr. Henry still was superintendent. The president and principal owner was the Oliver F. Winchester, who, from being a stock-holder in the preceding companies, then first publicly appeared as a manufacturer of arms. During the first few years of the life of the new company, Mr. Henry gave much of his time to experiments for the improvement of the arms, the ammunition of which had become obsolete.

In 1860 the New Haven Arms Company abandoned the manufacture of rifles and pistols using loaded bullets and bent their efforts upon the production of rifles only — Henry rifles, which used rim fire copper cartridges. The ammunition being a novelty, the company manufactured that too and adopted for a trademark the letter " H " (for Henry) stamped upon the heads of the shells. The Win-

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chester Company still uses that symbol on rim fire ammunition.

The New Haven Arms Company from 1860 until the end of its career made only one style of Henry rifle, although it ran the gamut from the plainest grade to the most elaborately ornamented and expensive; the weight was about 10 pounds, the barrel was 24" long, the calibre was .44. The cartridge held 25 grains of powder and a conical bullet of about half ounce weight —216 grains. The Henry barrel was bored cal. .42, rifled with 6 grooves each about .005 deep, making the actual calibre .43, to use a bullet of cal. .44. The grooves had an increasing — called a " gain " twist — beginning at the breech with one turn in 16 feet and ending at the muzzle with one turn in 2¾ feet.

The Henry rifle was considerably in use during the Civil War — a sporting rifle privately purchased to the extent of about 10,000 by entire companies and regiments of state troops in federal service. Although, even in sporting model by far the best military rifle in the world, the U. S. Government would not buy it. Lack of large funds and of government patronage held the company from expanding to fill its orders, which exceeded by about twenty times the possibilities of manufacture. During and after the war valuable testimonials of " Henry " service were written by the commanders of troops that with it defeated enemy troops many times outnumbering them.

Major Cloudman of the 1st D. C. Cavalry, in a

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letter to Mr. Winchester, said that when he was held in Libby Prison he often heard the enemy discuss the merits of Henry rifles, and he heard one of them say, "Give us anything but that damned Yankee rifle that can be loaded Sunday and fired all the week."

Capt. Wilson of Co. M., 12th Kentucky Cavalry, while visiting his home, learned of a plot to kill him. So he kept his Henry rifle across the road from his front door in a corn-crib, which he purposed using as a refuge. One day while dining with his family the captain was surprised by seven mounted guerillas. Capt. Wilson exclaimed, "If you wish to murder me don't do it at my own table in the presence of my family." The guerillas consented to his going out of doors to be shot. The moment he reached the front door he sprang for his shelter and the guerillas commenced firing at him. He reached the corn-crib, seized his Henry rifle, and with five shots killed five of them. The other two sprang for their horses. As the sixth man threw his hand over the pommel of his saddle the sixth shot took off all four of his fingers; notwithstanding, he got into his saddle, but the seventh shot killed him. Then, starting out, Capt. Wilson killed the seventh man with the eighth shot. In consequence of this feat the State of Kentucky armed his company with Henry rifles.

Col. J. T. Wilder, 5th Div. 14th Army Corps, stated, "My Brigade of Mounted Infantry has repeatedly routed and driven largely superior forces of rebels, in some instances five or six times our number. Since using the Henry we have never been

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driven a single rod by any kind of force or number of the enemy. I believe the Henry rifles to be the best arms for army use that I have ever seen."

Criticism, however, is sometimes more helpful than praise. Major J. S. Baker, in a letter dated from the field before Richmond, Jan. 20, 1865, wrote: "But notwithstanding my high opinion of this arm when in the hands of dismounted men, I do not think it a suitable weapon for cavalry. I consider it too heavy; the coil spring used in the magazine is also liable in the cavalry to become foul with sand and mud, and this, for the time being, renders the arm unserviceable."

This voicing of an undeniable fault turned a Henry rifle into a Winchester. Mr. Winchester bought the patent of Nelson King for loading the magazine through a gate in the frame, and was thereby enabled to furnish magazine tubes without an opening on the exterior through which the coiled spring could become dirt-clogged.

In 1866 the New Haven Arms Company, disorganized, reappeared as The Winchester Repeating Arms Company, located in Bridgeport, Conn., where it stayed until 1870, when it moved to new buildings in New Haven. From 1866 to 1873 it issued only one model of rifle, the Winchester Model 1866, using 44–28–200 r.f. ammunition having an initial velocity of only 1,125 f.s., and differing from the Henry only in the extractor, the closed magazine tube, and the loading gate in the right side of the frame. In 1869 the Winchester Company purchased the patents and

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property of the American Repeating Rifle Company — formerly the Fogerty Rifle Company of Boston — and in 1870 it bought the patents and property of the Spencer Repeating Rifle Company. The machinery of these two companies was moved to New Haven; the patents, most of them, were of more legal than industrial value.

The second model of Winchester rifle was the Model 1873. During the first two years of its production it differed from the Model 1866 mainly in the kind of cartridge it used, a center fire brass shell holding 40 grains of powder and a .44 calibre 200-grain conical bullet with a muzzle velocity of 1,325 f.s. This became the famous "Forty-four-forty" cartridge, which, in the days of old in the Far West, killed more game and savages than all others together of that time. In 1875 the Model 1873 rifle was provided with a sliding lid to the opening in the top of the frame, the frame was made of iron as well as of brass, and calibres other than .44 were issued. Also in 1875 the Winchester Company began making cartridges for arms of other makers.

The third variety of Winchester rifle was the Model 1876. This was merely the Model 1873 made larger and stronger so as to handle safely ammunition of greater range and power than the old 44–40. The manufacture of Model 1876 rifles was discontinued in 1897.

In 1876, at the Philadelphia Centennial, Mr. B. B. Hotchkiss, an American inventor, exhibited a model or sample bolt action repeating rifle. This arm

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caused so much comment, and was the subject of so much attention by Ordnance officers, as to lead American arms makers to think that it might be the coming gun. The Winchester Company bought the right to manufacture it, and then found it to be partly undeveloped. Two years of experimenting were necessary to perfect it. It was then tried by the U. S. Ordnance Board of 1878 and found satisfactory, and later ordered for the U. S. army in both carbine and rifle sizes. Meantime it was put on the market and called Model 1879 as a sporting arm in both plain and fancy grades, using, as did the two military patterns, the U. S. Government regulation 45–70–405 ammunition. A few years later it appeared as Model 1883 with a metal frame and an indicator on one side and a magazine cut-off on the other. Hotchkiss rifles, however, never attained the wide popularity expected, and the company soon stopped making them.

About this time the now celebrated arms inventor, John M. Browning, first established relations with this company by selling to it his invention of 1879 for a breech mechanism for a single shot rifle. This rifle became the Winchester Single Shot, and from the time the first one was put on the market in 1885 to the present day the Winchester Co. has been one of Mr. Browning's best customers. In fact, barring the Lee Straight Pull and three recoil operated rifles, Browning-Winchester correctly designates almost all of the company's other arms.

These data cover the origin and development of

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PLATE 50.—Winchester Rifles

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PLATE 51.—Winchester Rifles

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the W. R. A. Co.; data of more recent interest are contained in their catalogues.

WINCHESTER SPORTING REPEATING RIFLES

(For W. R. A. Co., military rifles see index)

PLATES 50 AND 51

No. 1, Model 1866. Bronze frame, open on top. Manufacture ceased about 1885. In 1866 it used only .44–28–200 rim fire copper shell ammunition; a few years later it was adapted to the .44 pointed (26–200), and the .44 flat (23–200); these two cartridges were developed for the Colt revolver as well as the '66 Winchester rifle. The sporting 1866 weighed 9 to 9½ pounds; the barrel was 24 inches long whether round or octagonal; the magazine was full length and held 16 cartridges; the retail price in the Eastern States was $22 and $23, the former price being for the round barrel rifle.

No. 1 A, Mechanism of Model 1866 Rifle.

No. 2, Model 1873. Until 1875 it was made with a bronze frame open on top; after that date, when iron was substituted for bronze in both the frame and the butt plate, the opening in the top of the frame was provided with a lid which could be slid forward by hand to cover it. When issued in 1873 this model was made only for the .44–40–200 center fire brass shell cartridge, sometimes called the "W. C. F.," but more commonly called the "Forty-four-forty." About 1885 the first change was made in its calibre; from then on it was made in a wide variety of calibres

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and styles; some of them long ago abandoned. The Forty-four-forty Model 1873 killed more game and men, the latter both red and white, than any other rifle.

No. 2A, Mechanism, open, of Model 1873 Rifle; also of the 1866, which was identical in principle. Also this was the mechanism of the Henry Rifle. An admirable combination of parts for the low power ammunition of the time.

No. 3, Model 1883, Hotchkiss. The several sporting patterns, having barrels of varying lengths and both round and octagonal, and having butts of several shapes, all used the U. S. Gov't. 45–70–405 ammunition. The magazine tube was contained in the butt, reached for loading by drawing back the bolt; it held 5 cartridges; they were inserted head first and pressed rearward. There was a magazine cut off on the right and a bolt lock on the left. The specimen shown has a metal frame interposed between the barrel and the butt; a number of these arms made a year or two earlier were made with the wood in one continuous piece from butt to fore end tip. Hotchkiss arms ceased about 1900.

No. 3A, Mechanism of the Hotchkiss Rifle. The good points of this design are at the present time embodied in bolt action rifles. The faults of the Hotchkiss were slowness of loading, whereby as a repeater it could be fired only about a dozen times a minute; and constantly shifting balance as the ammunition slid forward.

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No. 4, Model 1886. This was Browning's patent, designed to handle more powerful ammunition than the models '73 and '76. It was the strongest lever action repeating rifle on the market. It was adapted to a wide range of cartridges running between .38–55 and .50–110–300.

No. 4 A, Mechanism of Model 1886. The most interesting novelty is the means of locking the breech bolt strongly. The cut indicates plainly the two auxiliary bolts which operate vertically in grooves in the frame and in corresponding grooves each side of the breech bolt.

No. 5, Model 1890. Designed to use .22 rim fire ammunition exclusively. This was the first Winchester gun operated by a sliding fore end, commonly called the " Trombone Action " gun.

No. 5 A, Mechanism of the Model 1890. This device was an old one, recorded in England as early as 1854, and in use in America by the Colt Co. from 1884. J. M. Browning, the patentee, modified and improved the existing forms. The object, of course, in this sort of mechanism was rapidity of fire.

No. 6, Model 1894. This arm was designed to handle the more powerful of the black powder cartridges, such as the .32–40 and .38–55, and the medium calibre smokeless cartridges such as .25–35–86, .30–170 and .32–170.

No. 6 A, Mechanism of the Model 1894. This is a modification, patented by Mr. Browning, of the

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Model 1886, affording, perhaps, greater resistance to recoil by means of the additional tie bolt between the bottom of the locking bolt and the front end of the frame.

No. 7, Model 1895. This lever action box magazine gun was designed by Mr. Browning to meet the bolt action box magazine gun in even competition — or better it. The magazine took 5 cartridges; the gun was adapted to .30 U. S., .303 British, .38–72–275, and .40–72–330.

No. 7 A, Mechanism of Model 1895. The strong and safe locking system seems to be shown with sufficient detail not to need description. The magazine was loaded with cartridges one at a time, and not 5 at a time from a clip.

No. 8, Model 1897. Called the Lee Straight Pull. Adapted from the navy rifle designed by James Paris Lee and adopted by the U. S. Gov't. Calibre 6 mm (.236 inch). Smokeless powder, tin plated; copper jacket, hard lead bullet having 2,550 foot seconds initial velocity. The feature of the mechanism is a straight pull to the rear instead of the customary turn up and pull back. Never a popular arm. Manufacture discontinued after a few years.

No. 8 A, Mechanism of Model 1897. Loads with a clip of 5 cartridges inserted with one movement; this, together with the simplicity of the bolt movement, put it in the rapid fire class. The bolt locking and holding design was, however, of immature

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development, and there may have been grounds for the claim that the gun was unsafe, and there certainly were grounds for the claim that the bolt occasionally fell out at unexpected times. The bolt was held in place when closed by a latch which was released by the pull on the handle. The latch, however, was not intended to stand the full force of the recoil, and to this end a lug on the bolt and a corresponding lug on the frame diverted the rearward thrust from backwards to downwards. There are elements in this design that should be revised and corrected and again offered to the public in an improved bolt action arm.

No. 9, Model 1903. Automatic, calibre .22, using a specially designed rim fire cartridge.

No. 9 A, Mechanism of Model 1903. Showing that the magazine, which held 10 cartridges, was in the butt.

No. 10, Model 1905. Automatic, for special .32 and .35 smokeless powder ammunition.

No. 10 A, Mechanism of Model 1905. Showing that this rifle was adapted to a box magazine but was otherwise like that of Model 1903. These two rifles, together with Models 1907 and 1910, all operated on the same principle, that of a movable counterbalance. It was not new, but these four rifles were the first to use it successfully. The breech bolt, not locked to take the shock of recoil, was operated by a mass of movable metal, proportioned in weight to

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the weight of the bullet and the amount of thrust rearward, so that the thrust was partly utilized in overcoming the inertia of the counterbalance and the remainder was hardly more than enough to operate the mechanism. The counterbalance was contained in the hollow fore-end.

From this list, a complete one of all the radically different mechanisms of Winchester repeating sporting rifles which have been put on the market, either Model 1866 or Model 1873 could have been omitted because of their similarity; Model 1873 was described and illustrated merely because it had such extraordinary popularity in the years of long ago that it will always be of interest.

A complete list of Winchester sporting repeating rifles contains many not detailed by description or picture, because they were merely slight variants of preceding models. For instance: — Model 1876 was Model 1873 with larger and stronger parts. Model 1892 was Model 1886 with smaller parts. Model 1906 was Model 1900 revised. And Models 1907 and 1910 were Model 1905 adapted respectively to .351 and .401 special ammunition. Such arms are of individual rather than general interest.

Plate 52

WINCHESTER SINGLE SHOT RIFLES

No. 1, Called the "Winchester Single Shot," — J. M. Browning's patent of 1879 — was first issued in 1885. The mechanism was a modification of the Sharps' together with a combination of the good

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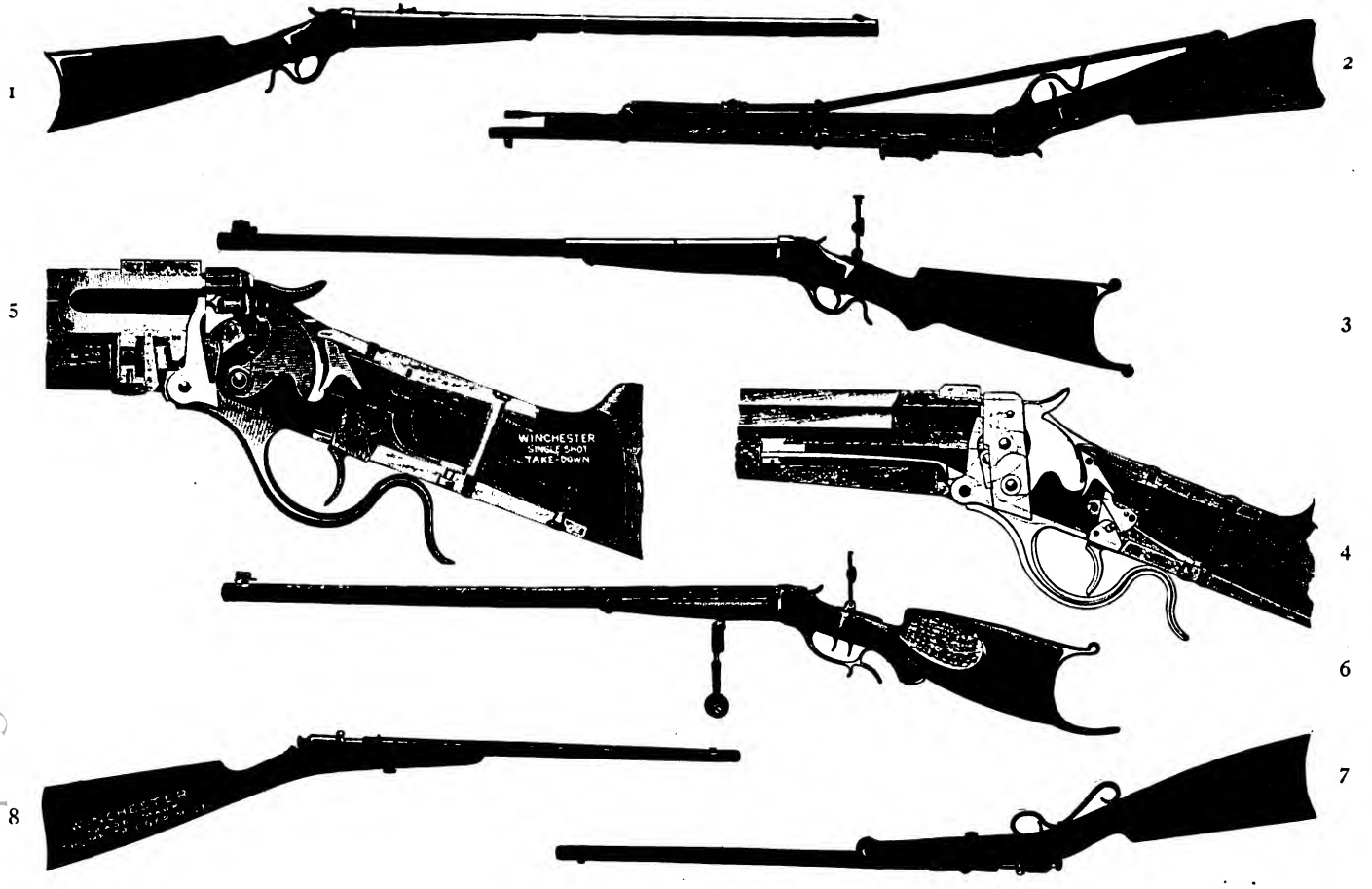

PLATE 52.—Winchester Single Shot

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features of several others. This action with different stocks and barrels was used in several varieties; they can hardly be called " models." The first Schuetzen was issued in 1897. In 1908 the mechanism was modified by substituting for the former flat mainspring underneath the barrel a coiled one attached to the breech block, and by changing the fly so as to leave the hammer at half cock when closing the action. At that time also a " take-down " device was provided, and the frame was thinned, lightened, and somewhat changed in outline. An early, unmodified specimen is shown by picture No. 5 on Plate 15.

No. 2 was called a " musket," and was intended for armory practice, by militia, with .22 calibre ammunition.

No. 3 was the fancy edition of the sporting rifle, this particular specimen on account of its heavy barrel and peep and globe sights being intended for target use rather than game shooting.

No. 4 shows the mechanism, or action, as it is more commonly called, as it was made prior to 1908.

No. 5 shows the mechanism, take-down device included, as it is made at present.

No. 6 is the Scheutzen variety, good, as illustrated, only for target work; but by changing the butt plate and the sights and removing the palm rest it can be used as a heavy weight hunting rifle.

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In 1900 this firm began the issue of a radically different type of rifle, also Mr. Browning's patent; an inexpensive, catch-penny affair intended for boys and people of small means; good also to tuck into a small space in a canoe or an automobile. So cheap that if ruined the first season the matter would be of no consequence; yet capable of accurate work at very short range. In 1902 it was discarded and re-issued slightly more attractive in external appearance. In 1904 the same thing in a trifle better grade was issued, and along with it one made without a trigger guard and provided with a push button on top of the grip in lieu of a trigger.

No. 7 shows the Model 1904, and

No. 8 shows the thumb trigger variant.

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Part IV

THE INTERESTED RIFLEMAN

For several years the high price of fixed ammunition has caused users of arms to revert to black powder, lead bullets, and home-loaded shells for short and mid range target practice. There has even been a revival of the use of muzzle loading arms, and not only have quantities of old-timers been resurrected from closets and attics, but moreover sporting goods dealers report extensive demand for them. Hence a rifleman of the present time and the near future will need a working knowledge of a wide range of obsolete as well as modern arms.

For the beginner to learn with, for the mid range rifleman's play hours, and for the sportsman afield who does not object to slow loading and a burden of paraphernalia, the muzzle loader has distinct charms of its own. And for the man whose recreation consists of a regular Saturday half-holiday spent at the 200-yard range, home loaded ammunition affords a heaping-full measure of the joy of that kind of shooting.

The owner of many arms should have a gun room. Have it on the second or third floor, not merely to be out of the family's way, but chiefly because in summer the air of upper rooms is dryer than that of those on the ground floor and less liable to cause rust.

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Arms ought to be in view because they are attractive; but they ought not to be bare on the wall because they gather dust and rust; keep them under glass. The picture shows a simple, appropriate, mahogany, single-glass-front wall case. Several such cases full of arms are astonishingly decorative.

It is obvious that the arms themselves are the decorative feature, not the case; the latter must be subordinate. It is simply a frame and a protector; treat it merely as such and have no ostentatious mouldings or useless gewgaws; but, on the other hand, have it of excellent workmanship, rich wood, and the best glass. In some houses, particularly those of Colonial type, and if the downstairs air is dry enough, two such cases of arms, one each side of a central window or door, may be appropriate and also distinctly decorative in a dining room or stairway hall, and of course in a billiard room; it depends upon the " atmosphere " of the house and the furnishings. But the exhibition of a large number of arms should be confined to the gun room, for the owner ought to respect the rights of his family in the home and ever bear in mind that a home is not a museum.

The best background inside a wall case is the same kind of covering which is on the adjacent walls; therefore select a wall covering in advance of locating the cases. Beware of paper with large figures or with conspicuous small bright ones which form a pattern of obtrusive spots; cartridge papers and " oatmeal " papers either in dull yellows or warm grays are sure

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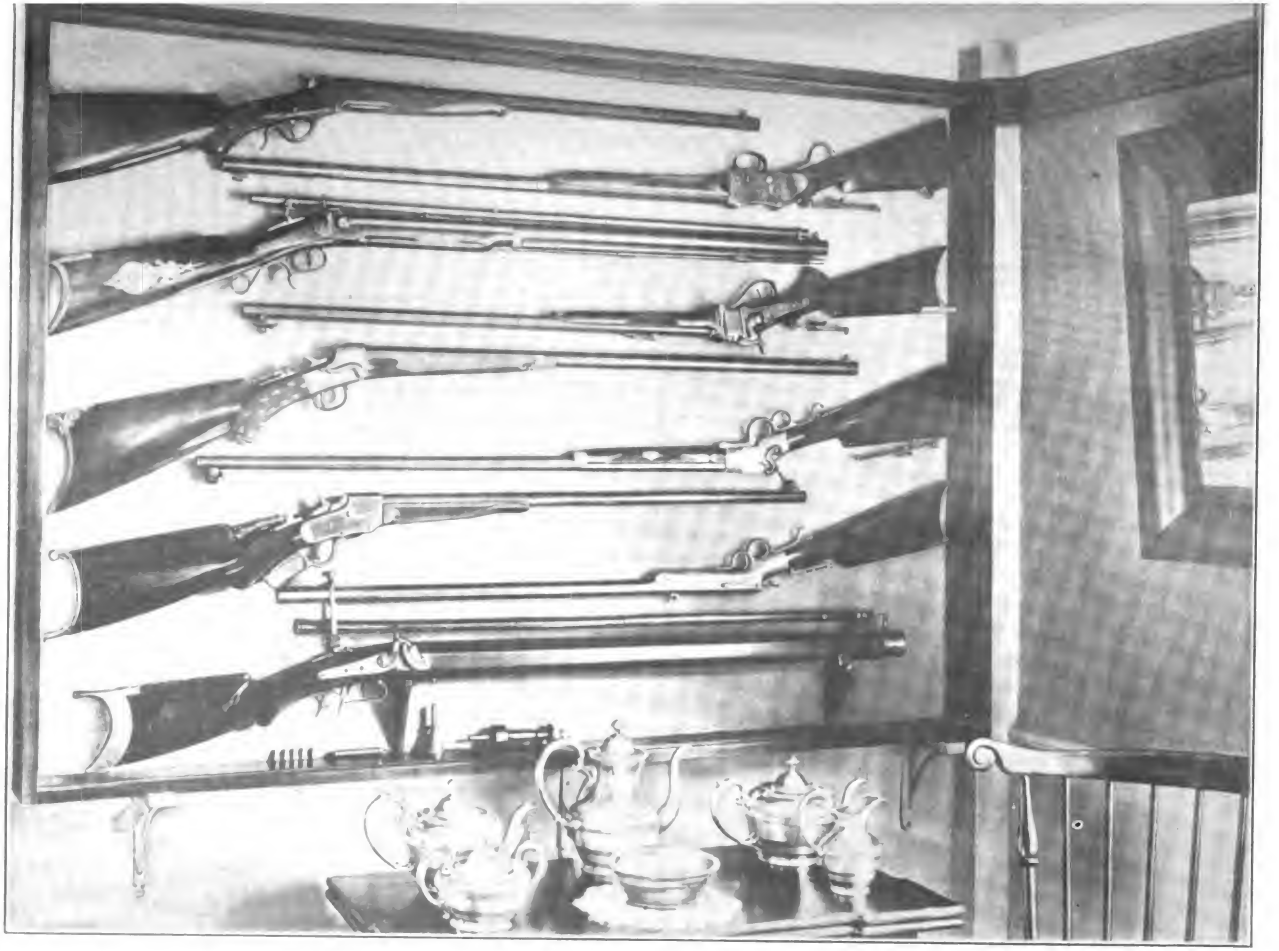

Wall Case for Arms

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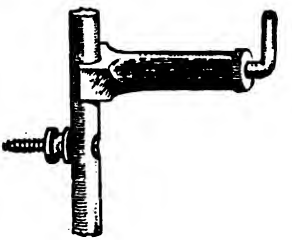
to be satisfactory if they harmonize also with the rest of the furnishings; if greater richness of color is required try the many shades of bronzed burlap until the right shade and tone are found.

Arrange the arms in a wall case formally and symmetrically; placed in any other way they are not at their best. Let the barrels of shoulder arms be horizontal. For the sake of convenience and also to avoid disfiguring the background with holes when changing the display, adjustable sliding hooks ought to be used. Adjustable hooks can be had of hardware and sporting goods stores; these supports slide up and down on steel rods, turn to either side, push in and pull out to accommodate varying thicknesses of stock and barrel, and can be fastened and loosed instantly in any position, and their number increased or decreased without leaving any marks. They are well worth their slight cost above ordinary nails or screw hooks.



Furnish the gun room with at least one set of drawers for the impedimenta of arms, a table of good size, and both straight back and easy chairs. Have the furniture of a kind as to style and wood; mahogany reproductions of Chippendale patterns are eminently satisfactory. Over the fireplace a game head with a couple of valueless ancient guns, crossed, and pendant powder horns and ditty bag or knapsack. On the mantel the appurtenances of arms and shoot-

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ing; not many. On the polished floor one good rug. If the air of the room smells a bit of good tobacco and leather and scented oil, no matter, for there are no draperies to make the room stuffy; above all keep the Feminine Touch out of the gun room.

For arms-educated individuals of technical skill and good taste there doubtless will be a workroom opening out of the gun room. All other individuals ought to be penalized if they tinker with arms; and as for amateur restorations and alterations of antique arms, that is morally reprehensible indeed, for not only can a fine specimen be ruined easier than a child can spoil a toy, but worse yet, if skilful incorrect alterations are made upon ancient military arms the attempt is always made to pass them as original, and thereby historical confusion becomes worse confounded. If all of us collectors will have workrooms, let us all always bear in mind this axiom: any fool can so injure an antique that neither money nor wisdom can restore it.

Keep a workroom absolutely neat and orderly; have a place for everything, everything in its place, and every tool spick and span, sharp, clean and perfect. Abundant electric light is necessary to the man who works nights: electric light, because any other kind may cause explosions. The same current can be converted into power for running a lathe and other machines. Have a screw-cutting lathe, and provide it liberally with assorted face plates, dead centers, chucks, holders, and tools for both metal and wood; a lathe with its adjuncts is a wonder

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worker. Let the lathe have a wide variety of speeds: low for steel and as high as 5,000 r. p. m. for wood. Other requisites for the workroom are a set of gunsmith's tools, chemicals in considerable variety, a small forge, and arms materials in small amounts of each but in kinds to cover a wide range of activities. All this equipment is to the end of experimentation in modern arms development; so equipped an arms "fan" will enjoy a green old age which to the very last will blossom with the joy of living.

Firing a rifle. This subject, which includes aiming, holding, squeezing, judgment of distance, etc., includes no new discoveries, and has for many years been so thoroughly treated by thoroughly competent marksmen-writers that repetition is undesirable. It goes without saying that the intelligent rifleman will have a shooter's library, and nothing can be added at this date to improve upon what has been said by such able authors as Colonel Whelan, Dr. Mann, Greener, Walsh, Winans, Sharpe, Fremantle, etc., etc. Also a beginner is referred first of all to the catalogues and pamphlets issued gratis by nearly all the arms manufacturers; some of them are admirable instructors.

Cleaning a rifle. This is a simple task for black powder residue and sometimes a difficult one for the after-results of the use of smokeless powder and nickel jacketed bullets. When using black powder and lead bullet, an excellent way is to wind the jagged end of the cleaning rod with absorbent cotton, wet with benzine or gasoline, and push through the

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rifle from the breech. Repeat indefinitely with fresh cotton each time until the cotton issues unsoiled. Then wipe the cleaning rod dry, saturate freshly wound cotton with gun grease, and scrub the bore thoroughly. For the mere residue of black powder this process is sufficient. But if there is lead adhering to the bore first clean as well as possible under the circumstances, paying particular care to remove all grease; strong, hot, sal soda water poured through the barrel does this; then plug one end of the barrel, fill above the lead with mercury, plug the other end, let stand about a quarter hour and shake violently several times in the meantime. Pour out the mercury and scrub the bore with canton flannel; the amalgam of lead and mercury will be so soft that it will come off onto the wiper. If a rifleman is a bit of a chemist he may hasten the removal of lead by substituting for mercury either acetic acid or some one of the many other lead eaters; but beware of the chemical that has not merely an affinity for lead but also for any of the compounds or elements that, with iron, are in the composition of a modern rifle barrel.

The after effects of the use of smokeless powder and jacketed bullet need another sort of treatment entirely. In this case cleaning is best effected by a conjunction of the three processes of washing, chemical action, and residue abraiding. This is because the barrel is dirty in several ways. First, the powder residue is to be removed to make the surface as bare

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as possible; next, that part of the residue which has been forced by the tremendous pressure into the pores of the steel, and also that which is beneath a thin plating left by the bullet jacket, and, worse yet, the metal fouling itself which may even be lumped on the lands, must be softened by chemicals; last of all, any softened metal left in the barrel after it looks clean must be scoured out with something which will not scour the steel of the barrel; if this abrasive has also an affinity for the soft metal in the barrel so much the better. Therefore,

First, turn the barrel muzzle down, insert a funnel in the breech, and pour through it a quart of boiling water which holds in solution a quarter pound of sal soda; that does the washing.

Second, cork the breech, stand the barrel muzzle up, fit a piece of rubber hose three or four inches long over the muzzle, and fill the barrel, and the hose to a point above the muzzle, with either of the following solutions: —

U. S. Army Formula	1 ounce ammonium persulphate 200 grains ammonium carbonate 6 ounces ammonia 4 ounces water

or

Chas. Newton Formula	1 ounce stronger ammonia 25 grains ammonium carbonate 5 grains ammonium dichromate 50 grains ammonium persulphate

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The liquid should remain in the barrel from 15 minutes to 2 hours according to the extremity of the case of fouling. It may be returned to its bottle and used again; a pint should be good for cleaning a barrel a dozen to fifteen times; but it should not be used when more than a fortnight old. The bottle must have a rubber stopper. If the liquid is spilled on the wood of the gun it will make a permanent black place; if allowed to dry in or on the barrel it will produce rust. Therefore dry the barrel thoroughly on the outside with cloth and on the inside with tufts, on the wiping rod, of either absorbent cotton or surgeons' absorbent gauze. If the muzzle of a rifle will not, from its shape, permit the use of a piece of rubber hose, it will be necessary to fill the barrel absolutely full and stay with it while it is soaking and pour a few drops occasionally into the muzzle so as to keep the barrel continually full, because the volume of the solution decreases rapidly and rust would form where the solution dried. After pouring out the solution the barrel may look clean and yet may not be clean. That is why the use of a friable abrasive becomes necessary. Hence,

Third, wind the tip of the cleaning rod with absorbent cotton or with gauze and cover it liberally with Grey Powder. Swab energetically with fresh applications until the Grey Powder issues unchanged in color.

The bore of the rifle is then probably perfectly clean. But to make sure, it is best to use the guage test. A guage of this sort is a short, cylindrical

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piece of metal with or without rifling ridges on it, and it goes into the barrel and through it with the least possible tolerance. In America this necessary adjunct to a rifleman's equipment cannot be bought ready-made, presumably because arms manufacturers would not be pleased at the revelation of the inferior boring of their barrels; but in Great Britain at least one arms plant issues barrels so accurately bored that it also issues (at moderate price) gages guaranteed correct to the ten-thousandth of an inch, which not only prove the accurate workmanship within the barrel but also serve, subsequently, as gages of cleanliness. These English gages test the bore only, not the grooving. Ultimately we must have them. The American rifleman using a barrel having corners to its grooves would do well to have a gunsmith cast an antimony-compound gage for his barrel, which, gently slid along, not only would test for metal fouling on the lands (bore) but would also at the same time push out residue from the corners of the grooves. Never thrust a gage of any kind, hard or soft, forcibly through a barrel; when pushed gently it either goes hard or sticks if it meets even the thinnest obstruction. Hence it not only detects but also locates a metal fouled or otherwise uncleaned spot.

When a barrel has been made clean and then tested, and stands the test, it can be set away, after being thoroughly covered inside and out with a chemically pure grease, and remain perfect indefinitely. To be sure that the grease is not rancid and

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will not become so, and that with age it will not break down, it is best to use one of the gun greases that the sporting goods sell; there are many of them with different names, one as good as the other.

These preceding directions are intended to meet the needs of difficult cleaning. There is a vast difference in the steel of rifle barrels — in hardness, porosity, and in susceptibility to take metal fouling and to rust—and many a man who has found that his own particular rifle could be kept perfect without the use of a cleaning solution and with almost no work may turn up his nose at these directions. But if he gets a new rifle, or changes his ammunition, all of these, and gumption besides, may be required to the fullest extent.

Reloading used shells. If they have considerable residue inside, wind enough absorbent cotton on a dowel to fill the diameter of the shells, spin the dowel in the lathe and use it as a brush inside the shells. Then use *accurate* decapping and recapping instruments. When loading the powder in them, the best results will come from weighing each charge accurately, and tolerances should not exceed plus or minus one-tenth of a grain; the less tolerance the better. Gage or caliper the bullets to insure getting all alike, and weigh each one; load them only into shells that are precisely of the same length, and that are of precisely the same external and internal diameter at the mouth, and that have even wall thickness for the distance that the bullet touches. For rough-and-ready short distance shooting these precautions

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are not necessary; but to make a rifle do the best that it can do these are but the outlines of the refinements necessary; bear always in mind that accurate repetition of the complex depends absolutely upon accurate repetition of all the individual components.

Bullets and molds. Bullets, if metal jacketed — full or soft nose — must be purchased, because the expensive and powerful machinery for making them lies outside the realm of the amateur. But other bullets may be home-made. Molds for casting all the common kinds are commercial commodities; molds for special bullets the amateur can make, preferably, because easiest, by recutting an old mold. The first step is to prepare a cherry having the exact size and shape of the desired bullet, except that in some cases its dimensions should be a thousandth of an inch greater to allow for shrinkage as the lead cools. The cherry is turned in the lathe on one end of a steel rod previously annealed. It is then cut with a file to form teeth running either lengthways or diagonally; then hardened; then put in the lathe chuck and the halves of the mold clamped upon it while it turns. The cherry "beds" in the mold and makes the impression in which the bullet can be cast.

Lead bullets are commonly made of 39 parts lead and 1 part tin melted together. Adding tin hardens the bullet. A bullet harder still, yet not brittle, can be made of 89 parts lead, 10 parts mercury, and 1 part tin, by weight. Another good mixture is lead and antimony, varying according to the hardness

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required; it will be well to start with 1 of antimony to 35 of lead and increase the antimony only if the fired bullet shows signs of stripping; it is well to have the bullet as soft as possible. In case a mold casts a bullet a trifle small this antimony-lead composition is especially useful because it swells in cooling. And perhaps valuable results can come from experiments with Babbit Metal as a bullet material; this metal has remarkable minimum-friction qualities. Whatever a bullet composition, melt first that ingredient which has the highest melting point, and add the others in order, the lowest last. The melting points of metals are given in nearly all encyclopaedias. If there is a wide difference in this respect between the ingredients cover the melted composition with charcoal, or with a floating iron cover, to prevent excessive oxidation by the air.

The degree of hardness necessary to a bullet will depend upon the speed it is to have, whether the powder is quick or slow burning, the depth of the grooves and the pitch of the rifling. With deep rifling and slow pitch use a soft bullet; with high pressure powder and shallow grooves and quick pitch use a hard one.

Experiments with explosive bullets may be productive of valuable results. One may start by drilling, on the lathe, a hole in the front of the bullet of a size to take a rim fire cartridge, the rim of the cartridge being at the front of the bullet. In drilling lead use a lubricant freely or the drill will break. A more powerful explosion may be obtained by filling

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a hollow bullet with equal parts of sulphuret of antimony and chlorate of potass, mixed dry on a clean plate with a feather, and stoppered in the bullet with wax. This is a safe mixture to the extent of not being exploded in the rifle barrel by the jump of the bullet. Be careful with others.

Bullet coverings offer an excellent field for valuable research. The nickel-plated and nickel-alloy jackets now in use are poor ones because of the affinity that nickel and steel have for each other under the influence of heat, pressure and friction, and the resultant metal fouling of the rifle barrel. An ideal covering would be one neutral to the steel, hard enough only to stand the strain on it, and slippery either from its composition, or with grease or other lubricant. One can start a line of experiments by winding bullets with insulated wire, by covering a lead core with a jacket of papier mâché containing ozokerite; by making composite bullets with bearings of Babbit Metal; by making copper, bronze, antimony, or other composite or homogeneous bullets having the periphery of their cylindrical parts spongy and filled with high-flash lubricant. In bullet design there is yet a great chance; but certain rules of the game must be followed; for instance, the desirability of — weight equal to or greater than that of present bullets of similar size; ease and cheapness of manufacture; center of gravity at or in front of center of length or of wind resistance; an outline which offers a minimum of resistance to the air at speeds exceeding 2,500 foot seconds. All this of course

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for bullets for average use; special bullets not included.

One line of experiments with bullets that is almost as old as rifles and as unprofitable as seeking perpetual motion is rifling a bullet instead of a barrel. The attempts nowadays rarely get to public notice, but still they persist. The last to be widely bruited was the McLeod attempt, but a short period of trial of this bullet proved its utter uselessness. Unquestionably a bullet from a smooth bore can be kept point end foremost by a drag behind and also it can be spun on its axis by the action of the air on " feathers " or on external or internal spiral channels; but the air resistance is so high that such a mechanical feature added to a projectile reduces the range to a mere fraction of that of a bullet operated by spirals in the barrel.

There is, however, another line of experiments, one connected with the revolution of a bullet on its axis, that will stand a lot of investigation, and that is the result of the speed of spin upon the object struck. For instance, we know that at some ranges a high speed sharp point full jacket bullet entering flesh drills a hole of its own size, while the same bullet at a different range may pulp the surrounding tissue within at least an inch radius, causing in effect a two-inch wound. The reason for it at present current is that the high speed entrance of a wedge into flesh causes the juices in the path of the bullet to fly sideways with macerating force. This has a logical sound but does not agree with the fact that

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the greatest pulping occurs at a distance from the rifle, while if the wedge-action theory were correct it would occur close to the rifle, where the bullet velocity was highest. But if we assume that the speed of the bullet on its axis causes the pulping by centrifugal force acting on both tissue and juice, the items of distance and laceration coordinate. Look at it this way: — using our '06 military bullet as a subject, at the muzzle the forward motion is about 2,700 f.s. and the rotary motion about 3,200 r. p. s.; the relation of the two is fractionally expressed $\frac{32}{27}\frac{00}{00}$. As the bullet travels, at first the velocity decreases rapidly while the spin remains almost undiminished, so that at a distance of, say, 400 yards, the velocity is only about 1,845 f.s., while the spin is still up to about 3,000 r. p. s.; fractionally expressed $\frac{30}{18}\frac{00}{45}$, and indicating a very different relation between the velocity and the rotation. Thus, apparently, the tremendous rotary motion has its best chance to do work when the bullet has traveled far enough for its velocity to be sufficiently reduced so that the passage of the bullet through a substance is slow enough compared with rotation to permit the rotation to get in its work. Under such circumstances pulping is probably accomplished mainly by centrifugal force. Hence it may be profitable to experiment toward augmenting the damage, not merely for sporting bullets, but especially for military ones. Try the effect of $\frac{3}{8}$ inch prongs or of a series of lumps lying flush along the sides of the bullet while it is in flight but raised by leverage or by wedge action upon

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the impact of the forward part of the bullet. By such means a one-inch hole may be cut by a small calibre bullet and perhaps a three to four inch laceration produced, which certainly would put any ordinary soldier out of action even when merely grazed.

Powder. Experiments by amateurs with moden high pressure powders are altogether too risky to be advocated, and it seems advisable, at least in this edition of OUR RIFLES, not even to give the compositions of nitro and pyro cellulose compounds. But our old friend and stand-by, common black powder, is a fairly stable article, easily and safely made, and many a gun user who would prefer to make his own powder can do so at a considerable saving. Perhaps the simplest directions for making black powder can be gleaned by each individual from a brief statement, omitting special processes, of how the deed is accomplished, on the average, in powder mills, because each man's home is variously equipped.

The ingredients are nitre, sulphur and charcoal. The nitre may be either saltpeter (KNO_3), or sodium nitrate ($NaNO_3$), or barium nitrate ($BaNO_3$). Saltpeter is for general purposes the best, sodium nitrate is usually cheaper, and barium nitrate is the best for a very damp climate. The functions of the three ingredients of gunpowder are, briefly: nitre supplies the oxygen necessary to combustion; sulphur lowers the temperature of ignition; charcoal assists in producing gas volume. Their usual proportions in gunpowder are, nitre 75%, sulphur 10%, charcoal 15%. These proportions may, however, be varied

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considerably to suit special purposes, the sulphur sometimes being reduced to 5%.

Crude saltpeter, technically known as "grough," reaches a powder mill in lumps and full of impurities. It is refined by boiling in water, removing the scum, filtering, crystallizing, washing, and drying.

Crude sulphur, just as it comes from the mines, also arrives in lumps, but mixed with sulphur meal and sulphur powder. The stuff is dumped in quantity into a cauldron and vaporized by heat to separate it into the kind of sulphur good for gunpowder and the kind good for domestic purposes. The vapors are passed through a water cooled pipe in which they liquify, and, of the consistency of treacle, they are run into wooden casks, where they solidify. Neither of these refining processes is open to the amateur, partly because of the excessively abundant and disagreeable fumes, and also and very particularly because at one stage, when the vapor is at a certain temperature, it is very dangerous, contact with the air causing a violent explosion. These data are given merely to satisfy curiosity and to emphasize the fact that all sulphur is not good gunpowder sulphur. Flower of sulphur, for instance, is not; the amateur will be most successful if he buys, through a wholesaler, crystal or stick sulphur; he can grind it with perfect safety as he needs it.

Charcoal, in American gunpowder, is made from either willow or alder; but it is entirely probable that some other soft light wood would do as well. The bark is first removed from the wood, otherwise

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there would be scintillation to the powder, which would be dangerous. The wood is then cooked in air-tight containers at a temperature not exceeding about 500 degrees Fahrenheit until it is evenly black and porus all the way through. The reason that the cooking temperature must not much exceed 500 degrees is that high temperature in cooking means high temperature necessary for exploding. The charcoal must not be used fresh; it is safe to incorporate it with the other ingredients after a few hours, but a much longer aging is better.

In some mills each ingredient is ground separately and in others all are ground together. After being reduced to fineness they are triturated together for a day or two to blend the three as perfectly as possible and then given great pressure (about a thousand pounds to the square inch) to form a slab about an inch thick. In some mills the rolling is one process and the slab making is another; in either case the mixture is first moistened; in the latter case the pressing is done just as a matrix is pressed in a cider mill. The object of pressing is to decrease the bulk and make stronger powder; also less friable grains of powder. The slab is broken into fragments and these are granulated. All this is safe if done so as not to produce a spark. The granulated powder is sifted in revolving drums covered with cloth of varying mesh to sort the grains according to size. Grains of a size are then put into revolving barrels where by friction with each other they become polished. Last of all comes kiln-drying, which is done slowly at low

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heat. The best powder nowadays is not graphited to blacken and polish the surface of the grains, but is merely friction polished.

All these processes can be done on a small scale with home-made press and implements. The result should be nearly as good as the product of the mill. Test it to see. Explosion should occur at close to 540 degrees Fahrenheit when the temperature of the surrounding air is about 70 degrees F. The result of explosion should be about 57% residue and 43% gas. Send a sample to an ammunition plant requesting the chamber pressure given by the powder when exploded in an '06 government shell behind the regulation bullet; the breech pressure should be about 43 tons to the square inch.

Try some experiments in raising the temperature of the powder before firing by using a water jacket of varying heat: at 212° see if the breech pressure is increased about 50%; note any tendency to detonate; note the effect upon the bullet: what useful application can you make of increasing the velocity of the bullet by heating the powder? How can you detonate the front tenth part of a charge in a shell wherewith to explode the remaining nine-tenths, and in what sort of rifle and with what sort of bullet would that be advantageous? Look up detonate, and explode, in a book on explosives. And once more, for emphasis, don't measure experimental charges; weigh them.

1 dram = $27\frac{11}{32}$ grains: 16 drams =
1 ounce = $437\frac{1}{2}$ grains: 16 ounces =
1 pound = 7,000 grains.

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Gasolene in guns. Gunpowder — of some sort — has for centuries remained a bullet propellant because it is dry, clean, safe to handle, and unaffected by ordinary climatic variations. But it is only one of a great many explosives, and it is nowadays much more expensive than many of the others.

In consideration of the facts that a bullet is propelled by a gas engine, that an automobile is propelled by a gas engine, and that the principles of the latter are applicable to the former, it seems remarkable that so little has been done in adapting gasolene to guns. It certainly is cheaper and much more powerful. A pound of gasolene, with the air mixture correct, equals in explosive power more than ten pounds of dynamite. Besides gasolene as a cheap explosive there is the even more powerful benzol, which, during the war, was used in the manufacture of TNT and other hi-power explosives. Oil chemists are fully capable of adapting the molecular construction of both gasolene and benzol to firearms, to use either separately or mixed.

In experimenting to substitute gasolene for gunpowder the inventor would best confine his efforts at first to machine guns having very stout barrels only a few inches long; and since the rate of fire can be very high the easiest way to feed the bullets to the gun, until a suitable hopper can be devised, is by a slight modification of the friction dial in use in ammunition factories. Otherwise the application of the principles of the automobile or the airplane engine to the machine gun is quite simple.

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Statistical imperfections. In the very beginning let it be understood that all statistics as to ammunition and ballistics whether here or in some other book are approximate. They are sometimes right (when other things coordinate), and always helpful; but they are not and cannot be definitely and unvaryingly exact. The ballistical data which follow are, of course, very elementary, because advanced ballistical mathematical formulæ and rules are of use only to certain scientists who know their origin and faults and what allowances to make; they would be neither useful, interesting, educational, nor even welcome to the average man. But with the full understanding that 7,000 grains in a pound divided by 12 bullets to the pound does not produce a bullet weighing exactly 583 grains; that a black powder weight of 2 and a spherical bullet weight of 1 does not produce exactly 2,135 foot seconds velocity; that the rule for finding muzzle velocity will not give it within 1 foot per second, nor even, at times, within 10 feet per second, on account of mitigating circumstances; nevertheless the data which follow are of sufficient accuracy to be valuable for ordinary circumstances.

Spherical bullets, unrivaled for certain short range purposes, will come into their own again with the return swing of the pendulum of fashion. The following table of spherical bullets to the pound is based on the supposition that the lead is pure and the temperature just below the melting point. The diameter given is theoretical and average. The

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weight per bullet is given without the fractional part of a grain which usually remains from division. The table begins with four to the pound, because no larger bullet is fired from the shoulder. The old-fashioned test for the right size ball for any rifle was to select the one which would slide down the clean barrel from the weight of the ramrod. Unpatched balls from which accurate work is expected must be gaged on account of the wide variations in diameter of those cast in the same mold, due to the expansion and contraction of both mold and melted lead under the influence of fluctuating temperature. (See p. 313.)

Bullet speeds with black powder. The following table gives an approximate to the average muzzle velocity of spherical bullets with varying charges of black powder. The proportions are by weight.

Lead	Powder	Speed, f.s.
1	1	2570
1½	1	2325
2	1	2135
2½	1	1975
3	1	1850
3½	1	1750
4	1	1670
4½	1	1600
5	1	1535
5½	1	1480
6	1	1425
6½	1	1375
7	1	1325
7½	1	1280
8	1	1235
8½	1	1200
9	1	1155
9½	1	1120
10	1	1035

With black powder and ogival head bullet, length between 2 and 3 diameters, a powder charge of one third the weight of the bullet gives a first second speed of about 1,600 ft. To find the velocity of any other charge, multiply the powder weight by 3, divide by weight of bullet, and multiply the sq. root of the quotient by 1600. The product will be the space covered by the bullet in the first second.

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Number of Balls in 1 lb.	Diameter (Cal.) in Inch-decimals	Weight in Grains Avoirdupois	Number of Balls in 1 lb.	Diameter (Cal.) in Inch-decimals	Weight in Grains Avoirdupois
4	1.052	1750, = ¼lb.	43	.476	162
5	.983	1400	44	.473	159
6	.924	1166	45	.469	155
7	.884	1000	46	.466	152
8	.843	875	47	.463	148
9	.804	777	48	.458	146
10	.786	700	49	.456	142
11	.762	636	50	.454	140
12	.747	583	51.05	.45	137
13	.734	538	54.61	.440	128
14	.713	500	58.50	.430	119
15	.703	466	60	.429	116
16	.662	437, = 1oz.	62.78	.420	111
17	.654	411	64	.416	109 = ¼oz.
18	.649	388	67.49	.410	103
19	.643	368	72.68	.400	96
20	.630	350	78.41	.390	89
21	.627	333	84.77	.380	82
22	.622	318	87	.375	80
23	.610	304	91.83	.370	76
24	.577	291	100	.36	70
25	.571	280	108.49	.350	64
26	.564	269	118.35	.340	59
27	.560	259	129.43	.33	54
28	.557	250	140	.323	50
29	.554	241	141.95	.32	49
30	.546	233	142	.319	48
31	.532	225	149	.313	47
32	.525	218, = ½oz.	156.14	.310	44
33	.520	212	172.28	.300	40
34	.515	205	190	.29	36
35	.510	200	200	.285	35
36	.506	194	210	.28	33
37	.501	189	220	.275	31
38	.497	184	232	.27	30
39	.491	179	244	.265	28
40	.483	175	256	.26	27
41	.484	170	270	.255	25
42	.480	166	285	.25	24

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Air resistance to high speed bullets. Air resistance is proportional to the square of the velocity when the latter is not over 900 f.s. and when it is above 3,000 f.s., but not for velocities between 900 and 3,000. There, it is approximately proportional to the square of the diameter. In figuring air resistance a number of influences must receive their allowance: velocity, diameter, shape of the tapered front, air density, etc. A starting-place for figuring being necessary, the start is made with the air resistance to a calibre 1-inch projectile having an ogival front; all cannon mathematical computations approximate closer than such for small arms, and the start is with the smallest cannon projectile.

At 1,000	f. s. it is about	2	pounds
1,100	" " " " "	4.25	"
1,500	" " " " "	10	"
2,000	" " " " "	16	"
2,500	" " " " "	23	"
3,000	" " " " "	30	"
3,500	" " " " "	39	"
4,000	" " " " "	49	"

For modern sharp-nosed bullets it is possible to lump together the factors of shape of the front and differences in air density and represent them by the decimal .06 for ranges up to 800 yards and by .07 for ranges beyond that. Suppose it necessary to find the air resistance to a bullet of calibre .30 having an average velocity of 3,000 f.s. over the distance it travels; it can be found to a close approximate by multiplying

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30 pounds (resistance to a 1-inch bullet at 3,000 f.s.)
9 (square of the diameter multipled by 100)
.06 (consolidated coefficient of reduction)
which produces 16.2 pounds, the information sought.

To find muzzle velocity. In the great arms and ammunition plants bullet speed is found with a chronograph, which gives the required information simply, quickly and accurately. The interested rifleman, lacking a chronograph of course, nevertheless has recourse to three other means of finding his bullet's speed: by the heat method, the ballistic pendulum, and gravity. Only the last two ways will appeal to the average ballistical information seeker. The ballistic pendulum may be a heavy, rectangular piece of wood hung by a cord, the line of which, produced, passes through the center of gravity. If m stands for the mass of the bullet, M the mass of the pendulum, v for the velocity of the bullet at impact, V the common velocity of the bullet and pendulum after impact (the wood holding the bullet), then mv equals (M+m)V. If the pendulum is close to the rifle muzzle, by solving for v the muzzle velocity is found near enough for practical purposes.

To find muzzle velocity by the gravity method, set the bore of the barrel exactly horizontal; shoot to the target, the distance of which from the muzzle is known precisely and the bull's-eye of which has been centered by sighting through the bore; measure the drop with all possible minuteness of precision. Let s equal the vertical distance fallen; g, 32.16 feet, the acceleration due to gravity; and t the time taken.

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Then s equals gt^2. Solving, and supposing for example that t equals $\frac{1}{27}$ of a second, if the distance from the muzzle to the target is 100 feet then the velocity is 2,700 feet per second.

Of course if the drop of the bullet is already known there is still another way of finding velocity, although not muzzle velocity. The equation for it is 16 feet: 1 second^2: : the drop in inches : the time in seconds^2. Supposing for example a drop at 100 yards of 26.597 inches; then

192 inches : 1 second^2 :: 26.597 inches : x

Solving, x equals .138526 square seconds; extracting the square root gives .3721 seconds, which is the time spent in dropping 26.597 inches and also in traversing 100 yards. From the foregoing we are now able to form another equation, the solution of which will furnish the desired velocity: —

the time : to the range :: 1 second : the velocity per second. Placing in this order the figures we have obtained we get

.3721 seconds : 300 feet :: 1 second : x Solving,

x = 806.23 foot seconds velocity.

This is not muzzle velocity but mean velocity for the 100 yards.

The drop of a bullet. The drop of a bullet may be calculated closely from the sight radius and the elevation of the rear sight by means of this equation: —

sight radius : elevation :: range : drop

The sight radius is the distance between the sights; the elevation is the height of the rear sight above the front sight.

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To calculate trajectory. As the sight radius is to the increase of elevation required between the shorter and longer range, so is the length of the shorter range to the height of the trajectory as it passes the shorter range on the way to the longer range. Thus, firing at 1,000 yards we wish to know the height of the bullet at 500 yards. The sight radius is 2 feet, and on the rear sight the distance between the 500 and 1,000 lines is $\frac{3}{4}$ of an inch. Then

2 feet : $\frac{3}{4}$ of an inch :: 500 yards : x Solving,

$x = 46\frac{7}{8}$ feet, which is the height of the trajectory at 500 yards when shooting to 1,000 yards.

And by the following method the height of the trajectory anywhere short of the target can be found if the angle of elevation can be measured. (One minute of angle equals 1.0472 inch at 100 yards.) From the angle for the whole distance deduct the angle for the shorter distance and convert the remainder into feet and inches for the shorter distance. Thus, to find the height of a bullet at 100 yards when shooting at a target 200 yards away, when at 200 yards the angle of elevation is 9.6′ and at 100 yards is 4.4′, — at 200 yards the bore of the barrel is pointing 20.22 inches above the mark; that is, the bullet falls 20.22 inches in 200 yards. At 100 yards the fall is 4.61 inches. Then in its 200 yard flight, at 100 yards the bullet will have fallen 4.61 inches out of the 10.11 inches which exists at 100 yards between the line of aim and the line of the barrel, or 5.5 inches, which will be the height of the bullet above the line of aim. This assumes that

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the line of aim passes through the axis of the bore; actually a slight correction should be made for the height of the front sight.

To plot a trajectory approximately. The square of double the time of flight in seconds is the height of the vertex in feet. Divide a range into a dozen or more parts and plot a vertex to each, then run a curved line through the vertices; this will be a close approximate to the actual curve of trajectory and will indicate, for the whole range, the danger zone to the enemy.

Wind drift. While the scientist can figure wind drift closely, the average man would require too much brushing-up of his mathematics to be interested to attempt it by the usual formulæ. It seems preferable to give rule-of-thumb directions which will enable a rifleman to get his first shot somewhere on the target, and from the shot-mark make corrections. For the first shot use the following as a basis for an estimate. An ounce projectile having its length about $1\frac{1}{2}$ times its diameter and an average velocity of 1,200 f.s. over a 1,000 yard flight will drift about 10 inches for each mile of wind speed when the wind is at right angles to its flight. When the wind is at 2, 4, 8, or 10 o'clock the drift will be about $\frac{2}{3}$ as much as at 9 o'clock; when the wind is at 1, 5, 7, or 11 o'clock, about $\frac{1}{3}$ as much as at 9 o'clock.

Angle of descent. Get from the maker of your rifle or ammunition a table of angles of sight elevations for the arm you are to use. Then, to find

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the angle of descent of your bullet at any range, first find the increase of angle required for the last yard of the distance at which it is desired to find the angle of descent. To do this add the increase of angle for the last 100 yards of this distance (A) to the increase of angle required for the 100 yards beyond it (B), and divide the sum by 200; this will give the mean increase of angle for each yard of these 200 yards. Correct this mean increase for the precise yard in question by subtracting $\frac{A+B}{100}$. The formula then will be, if you are shooting at 1,000 yards and designate that (N),

N $\frac{A+B}{200}-\frac{A+B}{100}$ = the angle of descent of the bullet in minutes of angle. Example: — from your table of angles of sight elevation you get for

900 yards angle $1°-14'-29766''$
1000 " " $1°-28'-10218''$
1100 " " $1°-43'-19620''$; then
$1000 \times \frac{(13'-804''+15'-094'')}{200} - \frac{(13'-804''+15'-094'')}{100} =$
$144'-201'' = 2°-24'-201''$, which is the angle of descent for the last yard.

Striking energy. Multiply the square of the velocity by the weight of the bullet in pounds and divide by twice gravity. For instance, suppose it desirable to know if the striking energy of a military projectile is sufficient at 800 yards to penetrate a certain shield or barricade, and you know the weight of your bullet to be 150 grains and figure its velocity at 800 yards to be 1,250 foot seconds. Square the velocity, 1,250, and get 1,562,500; multiply by $\frac{150}{7000}$ (the number of grains in the bullet divided by the

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number of grains in a pound), and the product is 33482.1; divide by twice gravity (2 x 16) and the quotient is 1,046 pounds of striking energy.

From this 1,046 pounds, and the area of the cross section of your bullet, and the coefficient of the resistance of materials to be found in your Engineers' Hand Book, in a very few minutes you can ascertain whether your bullet can reach the vitals of your enemy behind his barricade of wood, earth, brick, or steel. If one shot will not go through, accurate shooting will soon cut a hole even through two feet of masonry.

Millimeter and calibre. A millimeter is the one-thousandth part of a meter, which is 39.37 inches long. A millimeter is therefore the .03937 part of an inch. Hence a calibre of, say, 7 m.m. is, in inch fractions, 7 x .03937, or calibre .275. Reversing, to find the millimeter calibre of an arm that is, say, calibre .303, divide by .03937, which gives 7.69 m.m.

Range Finding. For distances much beyond the so-called " point blank " of a rifle the necessity of knowing closely the distance to be shot over is so very important that a hunter of big game " in vast silent places " really ought to carry a range finder. Not, if it can be avoided, one of the cumbersome modern artillery range finders, but a three-piece affair, each piece about as big as a thimble, to snap onto the rifle barrel; a pair of prismatic reflectors at the two ends and an eye-piece to be placed between them; at present there is no such instrument on the market but you can easily design one.

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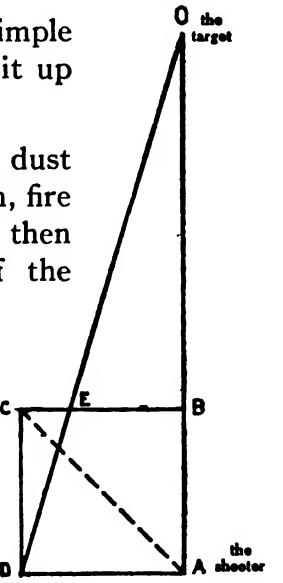
The next best portable instrument is your field glass equipped with a range scale. Lacking these, rule-of-thumb methods will have to be resorted to; unless the sheep lying on the mountain side a mile away are so accommodating as to permit you to use method No. 4.

No. 1, Rough approximate when water or level ground is on the one hand and level ground on the other: — stand like a ramrod, bow your head until the hat brim seems to touch the target, pivot on the heel and note where the hat brim cuts land. Pace the distance.

No. 2, By the mil method; simple but too wordy to give here; look it up in a book on artillery practice.

No. 3, By bracketing. When dust or water will show a bullet splash, fire with sight purposely set too low, then too high; note the position of the target between them, and for the third shot adjust the sight to hit.



No. 4, By triangulation. Make ABC and ADC right triangles by the 3, 4, 5 method, B being on the line of sight. Stand at D, look towards O, and mark point E on BC. Measure CE. Then

$$CE : CD :: DA : AO$$

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No. 5, By sound, for distances evidently beyond 400 yards. From the crack of the rifle to the sound of the blow count seconds, preferably with a watch. The time includes the flight of the bullet and the return of the sound of the blow; halve it. The speed of sound averages 1,100 f.s. Multiply.

RIFLE ACCESSORIES

Information regarding tools for casting, sizing, lubricating and seating bullets; for capping, decapping, sizing, opening and crimping shells; and about machines for measuring powder with a fair amount of accuracy, can be had in the Ideal Handbook, which is or at least long has been distributed gratis by sporting goods stores to customers.

Bullet seater. In target shooting with lead bullets there is advantage to seating the bullet separately in the rifling ahead of the shell. It can be done very well indeed by pushing the bullet with a plunger through an empty shell, the head of which has been bored through.

False Muzzle. In target shooting with lead bullets and metallic cartridges the most accurate results have been obtained by seating the bullet from the muzzle, just exactly as in the days of the old muzzle loader. It is believed that a bullet seated from the muzzle flies more accurately because its base is more perfect than that of one which first goes through the grooves from the breech. When a lead bullet starts from the breech the lands of the barrel in cutting backwards along the bullet project burrs

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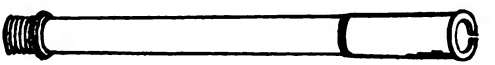
rearward from the base of the bullet, and any unevenness in the size or shape of the burrs causes tipping of the bullet as it leaves the muzzle. On the other hand, when a lead bullet is loaded from the muzzle it goes down rear end first and the lands cut forward on it and leave the base undamaged, or nearly so. Also, with the assistance of a false muzzle a bullet loaded from the muzzle reaches the breech centered in the bore, while if started in the usual way up the bore from the breech through a throat slightly too large the axis of the bullet may not coincide with that of the bore and therefore the base of the bullet is not square to the bore and upon exit from the muzzle the powder gas escapes first from the forward edge of the base and tips the bullet and causes a wobbling flight.

Auxiliary rifle barrels. An auxiliary rifle barrel, Shelton's patent, was a rifled tube to be put into the barrel of a shotgun. For single barrel shotguns it was a fairly good auxiliary, but for double barrel guns it never was popular, partly for the two reasons that it changed the balance not only fore and aft and also sideways, but more especially because of the difficulties in the way of accurate sighting. Auxiliary rifle barrels were on the market from about 1880 to about 1895; they were manufactured by the Winchester Co., in lengths averaging about 18 inches,



and by the Remington Co., of the full length of a shotgun barrel but not exceeding 32 inches. The

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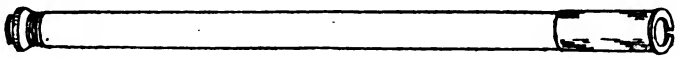
rear portion externally was the size and shape of a shotgun shell (10, 12, and 16 gage), while the forward end was centered in the gun barrel by means of a fitted ring for Winchester auxiliary barrels, and for Remington barrels by a cone which screwed



down over the muzzle of the rifle barrel until it engaged the bore of the muzzle of the shotgun barrel. Auxiliary rifle barrels were made for about all the center fire cartridges then on the market; after the first few years they were provided with automatic ejectors operated by the extractor of the gun. The average retail price was about $12.00.

These auxiliary barrels never became popular. Users voiced many protests, among which the most sensible sounding ones were as follows: the auxiliary barrel could not be inserted and removed instantly like a cartridge but required considerable time and pains, so that the tendency was to leave it in place; therefore the shotgun itself became in effect a single barrel one, unduly heavy, out of balance, and with a clumsy "feel." Moreover the rifle barrel shot inaccurately unless provided with sights attached to the shotgun barrel, and when using the double barrel shotgun the sights were both unsightly and a nuisance.

These auxiliary barrels are still found in good second hand serviceable order. Whether they are desirable for present day use each shooter must judge

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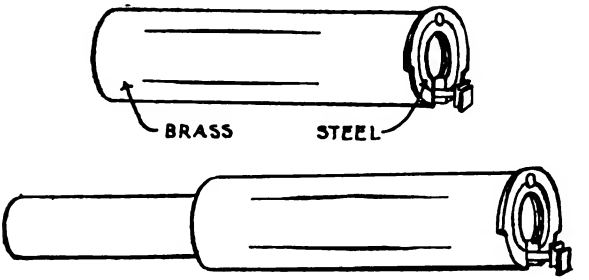
for himself, basing his judgment on probable conditions of use.

Following this device was the Elterich Rifle-bullet Shell, patented in 1901, and made for a few years by the J. Stevens Arms & Tool Co. The



Elterich was a brass shell containing a steel chamber for a bullet cartridge and a short piece of rifled barrel to start the bullet straight. The exterior of the brass shell was slotted and bulged outward to produce a spring effect, so that when the shell was put into the chamber of a shotgun barrel it would have a tight fit. Five varieties were made. No. 1, for repeating 10 and 12 gage shotguns only, was 2½ inches long and used .32 short S. & W. ammunition. This shell was not provided with an extractor. Nos. 2, 3, and 4, for single and double barrel guns only of gages from 10 to 16, varied in length from 2½ to 6 inches, were provided with extractors operated by the gun, and used cartridges of cf calibres .25, .32 and .38. The 5th variety, 10 inches long, was made either smooth bore or rifled. Prices of these shells were from $3.00 to $5.50 each according to size.

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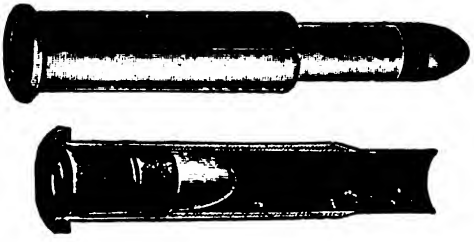
Supplemental Chamber. The supplemental chamber is the converse of the auxiliary rifle barrel; that is, the auxiliary barrel converts a short range arm into a longer range one, while the supplemental chamber permits the use in a powerful rifle of ammunition of greatly less power. The pictures tell the whole story of the cartridge within a shell.



With the supplemental chamber .22 rim fire ammunition can be fired in a .22 hi-power rifle; .32 S. & W. in. 30 and .303 rifles; .32 short Colt in .32–40; .38 S. & W. in .35; and .41 short Colt in .405 rifles. Only smokeless powder cartridges should be used with supplemental chambers because black powder in quick twist barrels leaves too much fouling.

Broken Shell Extractor. When the extractor of a rifle withdraws only the rear part of a shell which has become ruptured in the chamber, leaving the forward portion of the shell, if a broken shell extractor can be inserted and if it can then be withdrawn it is almost certain to take the piece of broken shell out with it. The pictures show the two principal de-

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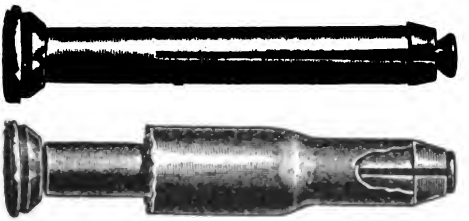
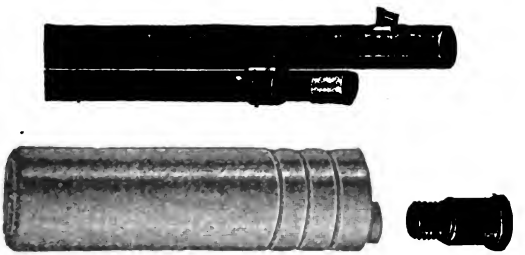


Extractor with section of broken shell

vices; both operated by wedge action although in a slightly different manner; sometimes one will do the work when the other won't.

Maxim Silencer. This adjunct to a firearm, fitted on the muzzle end, reduces to a very appreciable extent the sound of the explosion. It operates in much the same way as a muffler for an automobile.



Through the silencer, lengthwise, there is a clear passage for the bullet and surrounding the passage are laminæ for whirling and retarding the powder gas. In its present form it is a sort of necessary evil: a crude protuberance performing an incomplete function. The interested rifleman may yet simplify and improve it, thereby conferring a benefit and receiving, perhaps, a fortune.

The Vented Muzzle. In theory — and practice has

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not yet proved it — the bullet should issue from the muzzle without gas pressure in its base. It may be that the ancients held this theory, because wheel lock and flint lock rifles were commonly funneled at the muzzle and we have no right to assume that the only intention of the maker was to assist the entrance of the bullet into the muzzle. Further along towards modern times comes the Hall breechloader (our Model 1819 military rifle), very much funneled. We know that Swiss wheel lock rifles with funneled muzzles of some hundreds of years ago were accurate arms at short range, because there exist official records of really good shooting done with them; and we know that funneled Hall rifles were accurate military arms. Question: did their makers expect and intend that some relief should be given to the bullet just before it issued from the muzzle by the squirting past the bullet of a portion of the gas in an envelope cone? Coming a little further towards modern times, and this time during the use of conical bullets, there appeared, about a lifetime ago, a booklet called " Cleveland's Hints to Riflemen," in which the suggestion is offered, for relieving gas pressure at the muzzle, of cutting away alternate lands for a distance of two or three inches back. Mr. Cleveland seemed to believe it a device of importance; yet the suggestion fell dead upon the experimenting class of rifle fanatics. But the germ of the idea lived, and about fifteen years ago Mr. Perry E. Kent, of Utica, N. Y., patented a " vented muzzle." His idea was to let the gas out through holes

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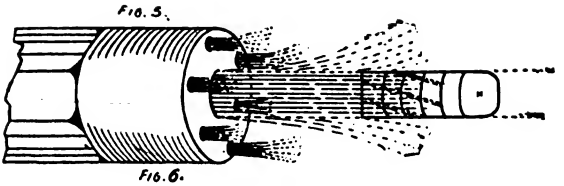

FIG. 5.

FIG. 6.

reaching from the grooves, some distance back from the muzzle, to the open air. At first he made the holes at right angles to the bore; later they made an angle with the bore and issued from the muzzle end of the barrel evenly spaced around the bore; by this second method he hoped to envelope the bullet, upon its exit from the muzzle, in a partial vacuum, to relieve the base of the bullet at that instant not only of rear pressure but also of side pressure. Apparently the vented muzzle remains unused. But it ought not to be dropped until its possibilities have been exhausted. Instead of cutting away the lands near the muzzle, why not leave them as guides and deepen the grooves, provided, of course, that the barrel is long enough so that the bullet base will not be gas-cut; and why not simplify the Maxim Silencer and the Kent vented muzzle and combine them and incorporate them within the barrel. But in groping along this path the inventor must avoid the existing snags; the silencer is a monstrosity; the Kent muzzle suggests more work in cleaning and added liability of rust. The public does not take kindly to complexities; improvements that simplify are more likely to be adopted.

Palm rest. In target shooting, using the hip rest

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position, many shooters prefer, instead of using the finger tips to support the rifle, to have a right angled extension fixed to the rifle, which can be grasped firmly with the whole of the left hand. A palm rest of the usual type is shown on the plate illustrating Stevens rifles attached to a target rifle (in Europe called match rifle). A variant on the market some years ago consisted of a ball of handsome hardwood having a gripper which fastened to the front part of the trigger guard.

Magnifying sights. Telescopes as sights for rifles fired off-hand should be of low power — certainly not above four — but should have large field and high illumination. Other than strictly observing these limitations there is a wide choice for the rifleman in both telescopes and mountings for them. But one cannot choose a sight of any kind that anywhere near approaches perfection. As to non-magnifying metallic sights, all now and ever formerly on the market are extremely unsatisfactory devices for pointing a rifle. The rifle sights of the future will of necessity be vastly different and must contain lenses in order that the target may be found quickly and seen clearly by eyes of qualities that vary greatly. And in order that rifle aiming may be instantaneous and practically automatic and at the same time correct— means must be found quite different from any now in use for range finding through the sights and for mounting and manipulating the sights. Some years ago a step in a general forward direction was taken with the attempt to introduce tubeless lens

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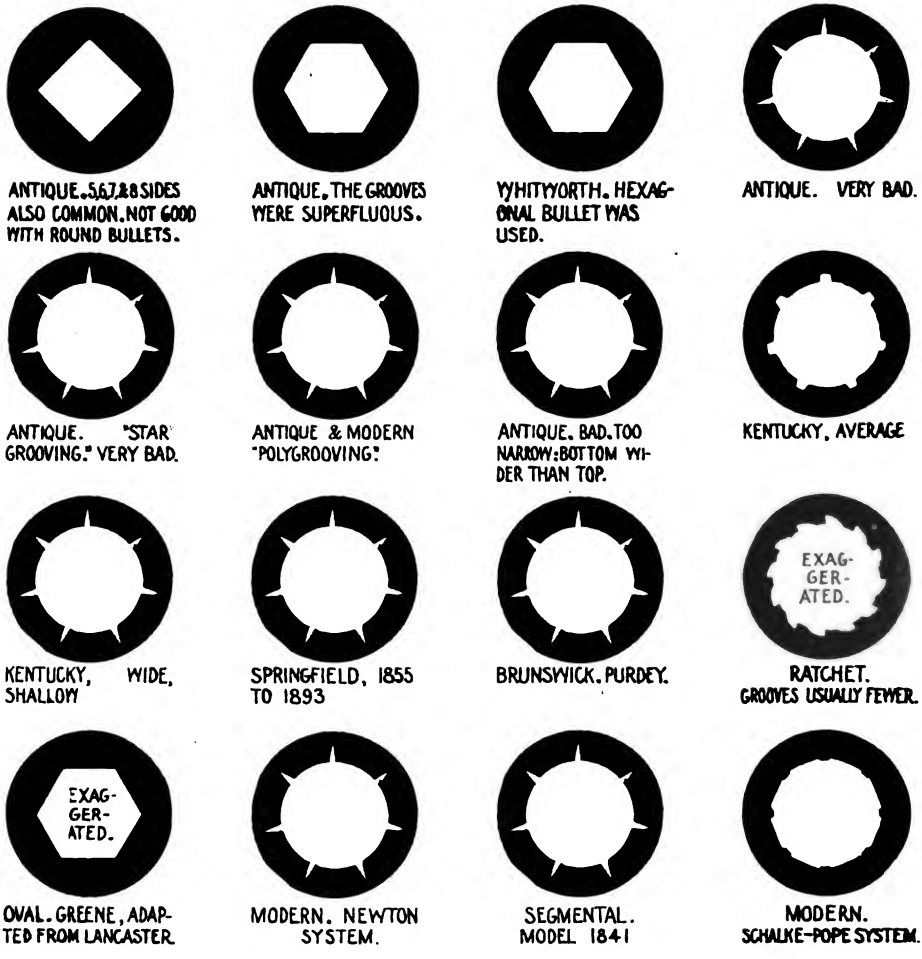

Types of Rifling

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sights, but they didn't go far enough, because they were merely adjuncts to ordinary metallic sights and also they were in some lights unsatisfactory because of disturbing light rays from the sides. The inventor may start with them and improve indefinitely.

Devices for teaching the "rookie" to hold. In our army training camps an expert marksman stands beside the rookie who is trying to learn to aim right and by looking into a small mirror which is attached to the rifle is able to see the rookie's faults and explain and correct them. Before the war our militia was taught to hold by practicing with the sub-target rifle, and by actual shooting with a .22 calibre rifle (in Europe called miniature rifle) in a rifle range built in an armory. There is now on the market a device attachable to a rifle by which "the office of the cartridge is performed by a sensitive pointer which traces on a diminutive target every motion of the rifle while it is in the act of being aimed and when the trigger is pulled instantly punches a small hole in the dot target and thus indicates the exact spot where a bullet would have struck the real target aimed at by the pupil."

Handwork by the Rifleman. If the amateur attempts to rifle a barrel on his screw cutting lathe he is free to choose any style of rifling ever devised, and apparently every style of boring, grooving and twisting that is possible has already been tried. The principal types or systems are shown on the adjoining page; they can be varied and combined almost without limit. In breech loading rifles, for a lead

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bullet it is not advisable to groove over four hundredths of an inch deep; for a jacketed bullet, not over four thousandths; for both, less may be better. For a lead bullet the ratchet, the Greene, and the Schalke-Pope systems, with or without combinations and variations, will produce accurate shooting. For a jacketed bullet the two groove, the oval, and the Newton may be preferable to any system which has sharp corners to its grooves. The interior of a barrel in process of cutting, or the interior of any barrel, may be reproduced in reverse for inspection or for accurate measurements by means of a sulphur cast. It is not best for a beginner to attempt varying the depth of the grooves from deep at breech to shallow at muzzle, as indicated on the Springfield (old) and segmental systems pictured; but the taper bore, before rifling, is easily within the ability of a careful beginner, and is obtained by lapping with a lead plug supplied with oil and flour of corundum. As the increase of diameter toward the breech should be gradual and not exceed two thousandths of an inch, considerable care is necessary, because corundum cuts very fast. The first few barrels better be cut in either iron or mild steel. The nearer to pure iron a barrel blank is, the easier to machine it accurately, and the harder the steel is the less is it likely to be either homogeneous or even in grain and the greater the difficulty to work it accurately. Chambering will have to be free enough to include the difference in diameter of shells of a kind, which will be about two thousandths of an inch. Very close chambering

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and throating may be desirable for special cartridges and usually will raise the velocity, but is worthless for commercial ammunition and raises the breech pressure tremendously and is unsafe for any other than an especially strong barrel.

Barrel renovating, internal. Many a barrel that looks to be badly rusted nevertheless is not pitted. Ordinary rust is removed by a gunsmith with a lead plug and either flour of emery or of pumice. Either one of them is a scouring medium that increases the size of the bore and partially obliterates the rifling: to a pitted barrel, which already therefore is a bad one, neither will do much damage. A rusted though not pitted barrel can be restored to about new condition by more gentle treatment. When the rust is tenacious enough to resist a wiping rag it can be dissolved with any one of the chemicals which has an affinity for iron oxide but not for iron; binoxalate of potassium is one; tetra oxalate of tin is another; crystals of these substances are soluble in hot water; the rusted barrel, filled with the hot solution, yields very quickly to the treatment. Another and generally better way is by scraping and then burnishing. The scraper, with a sharp but smooth edge, must be a bit softer than the barrel in order that it may not remove any metal but rust; the burnisher, of highly polished steel, must be exceedingly hard. Rust is of many varieties; one, seen under a microscope, may seem like a growth of toadstools springing from the pores of the steel; another may look like a bed of moss. Neither may have eaten away and lowered

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its bed from the original plane; hence a gentle scraping followed by burnishing will restore the smoothness of surface without increasing the size of the bore. Many barrels after such treatment show no sign, either visible or measurable with an internal micrometer, of ever having rusted a particle. When the scraping and burnishing cannot be done with a rifling machine but must be done by hand, the little tools should be bedded in a hard-solder plug cast in the barrel, and of course means must be provided for raising and lowering them by means of spring, wedge or screw.

Barrel renovating, external. Before a barrel either old or new can be coated either brown or blue the metal must be absolutely bare and clean. After polishing the metal, freeing it of grease is accomplished by coating it with a paste of lime and water or by boiling it in an aqueous solution of caustic soda. When wiped clean it is ready for treatment. But, previously, in surfacing, no good workman will round the flats of an octagonal barrel by filing or polishing across them. In cutting the old, abraded surface, if the lathe bed is long enough bed the barrel on the lathe bed and grind its flats smooth, using the screw cutting attachment to move the grinder lengthwise, revolving lengthwise. If necessary to cut the barrel surfaces by hand, do it by draw filing. The same applies to polishing; polish lengthwise; if by hand, with successive applications of finer and finer emery cloth on a large, flat, medium file. Muzzle loading rifle barrels, either flint or cap, were

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browned. Modern barrels are finished blue-black. In either case the process is one of oxidizing, commonly called rusting. After each coat of the oxidizing chemicals has caused a coat of rust, the rust is removed, all but the stain of it, with a wire brush, which leaves the surface of the barrel dark and shining. Successive coatings and scratchings increase the depth of the protective coating and also the color and evenness of it. The speed of the rusting depends to a great extent upon the temperature and humidity of the air. In arms plants a specially heated and humidified room makes the process equally certain all the year around; the man who does this tinkering at home may have to confine his oxidizing to the summer time. The final coat (brown, various shades) can be darkened, and also considerably changed in color, by pouring over the barrel boiling water containing either alum, logwood, or copperas, according to the depth and shade of color desired. Old-time figured barrels, — twist and damascus, made of steel and iron twisted and welded together — require special chemicals which stain one of the two metals more than the other and so show the figure. The first coat of chemical on either a plain or a figured barrel should be applied sparingly using a cloth soaked in the chemicals and then squeezed so dry that not another drop will come out of it. The cloth should be applied with a rolling motion so that a fresh part of it will continually reach the metal. Succeeding coatings may be wetter but not wet enough to permit the gathering of drain-

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ings at the bottom end of the barrel. The barrel must not be touched with the bare hands, because there is oil in the skin; custom has sanctioned the handling of it by wooden plugs driven into and projecting from each end. Good results were obtained in the days of long ago by very simple means: when nothing more rapid in effect was obtainable salt and water were used. Probably the majority of all early Kentuckies were colored with either formula No. 1, or No. 2; even these were slow.

No. 1, Sal ammoniac in hot water.

No. 2, Butter of antimony in hot olive oil.

No. 3, For our military rifles, 1800 to 1865; for plain sporting rifles of the same period; quicker process than either No. 1 or No. 2: —

$1\frac{1}{2}$ ounces alcohol
$1\frac{1}{2}$ " tincture of iron
$1\frac{1}{2}$ " corrosive sublimate
$1\frac{1}{2}$ " sweet spirits of nitre
1 " blue vitriol
$\frac{3}{4}$ " nitric acid
1 quart pure water

No. 4, For figured barrels.

1 ounce spirits of nitre
$\frac{3}{4}$ " tincture of steel
$\frac{1}{2}$ " sublimate of mercury
$\frac{1}{2}$ " bluestone
$\frac{1}{2}$ pint pure water

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Some of the old figured barrels show the figure in slight relief. This etching was done before the browning by immersing the barrel (plugged at both ends) in a lead trough containing enough fluid to cover the barrel. The fluid was obtained by boiling down to $\frac{3}{4}$ of its bulk 1 pound of sulphate of copper in 1 gallon of soft water. The etching requires 15 to 30 minutes.

No. 5, To duplicate the blue-black finish of our present military and sporting rifles is really a chemist's task because of the varied alloys with which different steels are hardened and the fact that a chemical mixture which produces blue on one kind may produce only rust brown on another. Process No. 5, however, usually produces blue-black; it is, in a way, an average of a number of formulæ. If it works unsatisfactorily on cold metal try it with the metal heated to about 150 degrees. If still refractory increase the amount of sulphate of copper in both the second and third liquids. Without knowing exactly the cause of ensuing failure no further advice will be of use except to send the browned metal together with the written formulae to an arms plant with a request for analysis and advice. Following is the average formula: — first, get a coat of rust by using formula No. 3; second, immerse in, if possible (if not, apply with a sponge), a solution of the following ingredients and keep the metal wet with the solution for at least 15 minutes:

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1 ounce tincture muriate of iron
1 " nitric ether
4 scruples sulphate of copper
3 grains oxymuriate of mercury
1 pint pure water

Dry the barrel and remove the dark rust with a scratch brush; repeat the use of formula No. 3, and this second liquid at least three times, scratch brushing the barrel to a polish each time; third, apply the following:

1 ounce nitric acid, specific gravity 1.2
1 " nitric ether
1 " alcohol
1 " muriate of iron
2 " copper sulphate
10 " pure water. In compounding this third liquid dissolve the copper sulphate in the water and add it to the mixture of the four other chemicals. When the coating of the barrel is sufficiently dark and even wash it clean with pure water, either hot or cold, and when dry finish once more and for the last time with the scratch brush. In the near future this long and tedious process will be simplified and infinitely hastened by galvanic action.

No. 6, Dark blue finish with grayish lustre:
4 ounces sodium hyposulphite, dissolved in
1 quart soft water; mix with
1¼ ounces lead acetate, dissolved in
1 quart soft water.

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Boil this mixed solution in a porcelain dish until evaporation has reduced the total to one quart. Warm the barrel to about 150 degrees Fahrenheit; apply the boiling-hot solution to the barrel with a sponge tied on a stick as many times as necessary to obtain the desired color. Time will average about one hour.

Try the experiment of combining this process with the copper-ammonium-disulphide process mentioned in Part V, alternating the applications.

No. 7, Black finish:

65 grams of this mixture {
- 57 cu. cm of strong phosphoric acid
- 18 grams pulverized zinc
- 57 cu. cm pure water

diluted with 10 litres water. Immerse for several hours. These seven (eight with the salt and water one), with final wash coats of water containing alum or logwood or sulphate of iron, will produce as many shades of color as will satisfy the average man.

No. 8, In case a barrel coating is very necessary in the dry season an enamel which will give a fine appearance and which has good wearing qualities can be made and applied this way: — dissolve 1 part of borax in 4 parts of water. Macerate 5 parts of bleached shellac in 5 parts of alcohol, saving out, however, a small portion of the alcohol for dissolving methylene blue of sufficient amount to make the desired color. Heat the watery solution to boiling and, constantly stirring, add the alcoholic solution.

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Stir out all lumps and add the blue solution. Before applying clean the metal bright. Apply with a soft, broad brush.

Brown, blue and black for rifle barrels and metal in general. Three colors; only three; two of them conspicuous and inharmonious with conditions and surroundings. How absurd. When all the colors of the spectrum are possible for sporting arms why is the public content with only one color? And will some Chief of Ordnance please distinguish himself by having the soldier's weapon match his uniform! With military rifles as they are, an air plane observer can see them when the soldiers themselves are not distinguishable. A terrestrial observer, estimating the number of troops in a movement, doesn't hope to nor try to see the length of the line of men; he sees the line of rifles. Uniforms fade into a background, but rifles are of first-class visibility. Khaki 'em. Olive drab 'em. Forest green 'em. Match 'em up.

Heat Bluing. Small parts of rifles, such as butt plates, trigger guards, bands, etc., are oxidized to dark blue by the heat process. First give the metal the required degree of polish and then clean it thoroughly of grease. It may then be heated in the open air, as some workmen prefer to do; as the temperature rises the following colors will appear in succession: — straw, copper, purple, red, gray, and then the desired dark-blue. The color does not go deep enough to wear well without carbonizing; so the metal is then bedded in a heap of vegetable

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charcoal, which is hot just above the smoldering point, and left 20 to 25 minutes. Whether or not the metal shall have inspections, wipings, and coatings of oil during its hot charcoal treatment is a matter of opinion; skilled workmen obtain equally good results both ways. When the metal is fully and evenly colored it may be allowed to cool in the open air, in which case it will be soft; or it may be chilled in oil to be hard; or in water to be harder yet.

See also the Buffington process of heat bluing described on page 377.

Tempering. Tempering steel to make it springy or hard or both consists for the most part of rearranging the molecular or the crystalline structure by chilling the steel suddenly from a high heat. The degree of heat varies according to requirements from cherry red to glowing temperature; and the medium into which steel is plunged to chill it varies from different densities of oil, for spring temper, to hot and cold water for greater hardness, to mercury for extreme hardness. Generally speaking, the harder steel is, the more brittle it is.

Making Springs. To make a flat spring of any shape: — select a bit of spring steel of sufficient size; anneal it; cut, file and bend it to the required form; heat to cherry red and plunge instantly into oil; return to the fire just long enough to burn off the oil that adheres to it but not long enough to heat the spring red. To make a coiled spring: — attach one end of a piece of piano wire to a mandrel somewhat

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smaller in diameter than the inside diameter of the coiled spring required; put the mandrel into the chuck and dead center of the lathe; pull the wire taut; start the lathe on low; as the wire winds on the mandrel guide the coil which is forming by means of any small tool which is as wide as the coils of the spring are to be far apart.

Casehardening. To produce the hard surface with mottled colors common to some arms of both the past and the present: — 1 quart of powdered animal charcoal, 1 tablespoonful of cyanide of potassium, 1 teaspoonful of prussiate of potass; stir well over a fire until the mixture nearly ceases smoking; put a layer in an iron box, set the metal article on it, cover and pack tight with the rest of the charcoal mixture, close the cover, heat in a clear fire until the contents become red, usually requiring 15 to 30 minutes; dump the entire contents of the box in water. Remove, dry, and clean with whiting. This treatment produces soft, blended tones. To get mottled colors in small, rain-drop-like patches of brilliant hues, dump the red-hot contents of the box into water which is being aerated either by means of a powerful stream of water squirted from a distance or by means of a blow pipe through which a stream of air agitates the water with bubbles. To get colors in specific places, mix a portion of the charcoal with the cyanide and cover one part of the steel with it; cover another part with prussiate mixture and a third with straight charcoal, etc.

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Stock Renovating

Removal of Dents. A shallow dent, caused by compression or by a blow, can, as no wood has been lost, be removed by swelling the compressed wood until it is once more flush with the surrounding surface. First bare the surface of the wood in the dent with a liquid grease killer if the stock was oil finished; a hot saturated solution of sal soda is good; if the stock was finished with shellac or varnish use a commercial varnish remover. Then cover the dent with water-soaked blotting paper and apply to it a hot iron, or, better yet, the point of a soldering copper. The resulting steam will, by repetition, swell out the dent. But a deep hole, say an eighth of an inch, can be corrected only by filling. If of small diameter use melted stick shellac mixed with color to match the wood. If large, bore out the place and plug with wood identical to the surroundings. In this case select a piece of wood of just the right kind, grain and color to match exactly, and turn it, across the grain, in the lathe, into a slightly tapered plug. Apply glue to the hole and the plug, set into place by driving lightly, cut off and finish. A piece broken from the stock or fore end can be replaced so as not to be noticeable, by a patient worker. If the stock has a curly grain, increase the regularity of the edges of the break by trimming with a chisel and when cutting in the direction the grain runs be careful to follow a grain line regardless of regularity. The next step, finding a bit of wood to match exactly,

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is often difficult but it is absolutely essential to making the repair a success. The matching piece must then be trimmed slowly, watchfully and patiently, with repeated trials of its fit, and when fitted it must be slightly tapering so that it will wedge into place. The last stages of fitting can be made faultless by smoking the edges of the plug each time before trying the fit; the points of its contact with the hole will then be marked on the edges of the hole and these places can be lowered until the entire surfaces meet. When the plug is satisfactory fit it into place and drill through it into the adjacent wood with drills made by breaking and sharpening needles. Remove and apply glue. Replace and drive the needle pins home.

To refinish a stock. First remove the old finish, making the wood bare and clean. If the wood shows signs in places of having absorbed lubricating oil, and particularly if such oil-soaked places occur where small pieces of wood must be glued in to replace chips broken out, the oil must be killed and removed by soaking the stock — all of it or part of it — in a boiling-hot saturated solution of sal soda in water. When dry, sandpaper smooth and then raise the grain by brushing with hot water; dry and repeat several times.

In all this abrading of the surface take pains not to injure the modeling, but improve it if possible. Turn the stock constantly, watching the ever-changing outline, and see that you are maintaining true curves. Hold one end toward the light frequently

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and observe if the reflections along the surface are true straight and curved lines. Modeling is as important in a fine stock as in a statue.

Then, as nearly all sporting rifle stocks are artificially enriched with color, stain it. For red, a rich, satisfying and unobtrusive red, use alkanet root in linseed oil; for brown, a mixture of Venetian red, or Indian red, with either Van Dyke brown or burnt ochre or burnt umber, or two of them or all three, will give rich color. These are but a few of many good combinations with average black walnut color; lampblack can be added to darken them; but always care must be taken that the stain and the natural color of the wood do not produce an unpleasant combination with each other, and that the re sulting effect combines agreeably with the other colors of the rifle — the colors of the metal parts. Instead of using lampblack to darken the color of the stock the effect can sometimes be gained by heating it while moving it rapidly over a clear flame; and by the heat method the shading can be graded and blended.

Then fill the pores with a purchased wood filler; rub with the grain. It is a safe rule to use transparent filler for dark wood and colored filler for light colored wood, but some people prefer the reverse. Let the stock dry and harden for a day or two, and then sandpaper again until the surface is glassy smooth. If the surface is a bit sticky, instead of sandpaper use steel wool — the finest grade, soft, like hair.

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Next comes the final surface finish. Some people prefer varnish. In this case apply successive coats of the best waterproof coach varnish with a wide, soft brush; allow at least 24 hours between each coat; smooth and polish each coat with pumice and water on wash leather. The last coat of all can be left this way, having what is popularly called an egg-shell finish, or it can be made a bit shinier by using oil instead of water with the pumice; or it can be brought to a high lustre by rubbing with dry whiting and wash leather.

Some people prefer a wax finish and others an oil finish. A wax finish can be obtained easily and quickly by using a commercial furniture wax and following the directions on the can. Or a stock can be wax finished with tan or ox blood shoe paste.

The admirers of oil finish claim that there is no other finish so satisfactory in the long run. But it takes lots of time to get it. Put a cupful of raw linseed oil and a pint of water in a large bottle and shake long and thoroughly, then stand the bottle in the sun for a couple of days. Decant the oil without the water and add to the oil a teaspoonful of drier (Japan). Once a day for a couple of weeks or perhaps a month anoint the wood with the oil and rub long and briskly with the palm of the hand so that the film of oil disappears and a soft lustre comes to the surface. In the beginning this lustre will disappear over night, but towards the end of the process it becomes lasting. There is a transparency and soft smoothness to this finish that brings out better than

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any other the richness of the color and figure in beautiful wood and makes a gunstock a delight to hand and eye.

Checkering. Checkering, on the grip and fore end of a rifle, serves the double purpose of utility and ornament; and because its object and its function is to make firm the grasp of the hand it should never be used for ornament alone and never placed in any other position than where the hand naturally holds the weapon. When done in the best manner it is fine-cut, shallow, crisp, perfectly regular, and bordered with pleasing outlines.

In laying out checkering the outline may be sketched with pencil for appropriate size and shape of area; the points of the angles of the outline ought then to be located accurately and symmetrically; then, if the lines connecting them are to be straight lines, they may be marked in the wood by stretching between the points a thin, hard string and hammering the string lightly to leave definite, true lines in the wood. If, however, the boundary of the checkering is to be curved, it is preferable to cut a thin card to the correct shape and tie it to the wood and then mark around it.

The intersecting incised lines which form the lozengers of the checkering are cut with checkering saws and finished with files. A checkering saw has two or more rows of parallel teeth. The exquisitely accurate work done on old-time high-grade European arms — Purdey double barrel rifle, for instance — was performed very slowly and carefully with a

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two-row saw; after the first cut was made one row of teeth on the saw ran in the last groove already cut, that groove serving to guide the other row of teeth to make an exactly parallel cut. Later, the number of rows of teeth became three or four in order to save time; but on sharply curved surfaces the quality of the work was lessened. Still later the Germans improved the checkering saw by adding to two rows of cutting teeth a steel blank guide actuated by a spring which caused the guiding blank to set fully down into a groove and act as a firmer guide for the two rows of teeth which did the cutting.

In modern American factories hand checkering is done far more rapidly than in olden times — and very much poorer — using a saw with many rows of parallel teeth and force enough to make them cut fast. Nowadays checkering a grip or fore end takes perhaps an hour and a half, while in former days a day and a half would be required for results of the highest grade. In addition to hand checkering there is machine checkering, in which the lozengers, of large size, are cut with a variety of circular saw.

Putting the final finish on new checkering, or cleaning out old, is done with a fine file, the blank space at the tip of which has first been broken off. If the rows of checkering are very close together it may be necessary to grind one face of the triangular file smooth in order to produce a sharper edge on the file so that it will reach to the bottom of the grooves. The shallow lines and flutes forming a border are cut with gravers and small gouging chisels. When

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the work with tools is done the checkering may advantageously be brushed with diluted varnish or shellac.

Checkering should not be soaked with oil nor even greased at all at any time, because of the obliterating and filling effects which detract both from the utility and the charm of this kind of surfacing.

Ornamentation

Those of us who spent precious years of our young lives learning to draw and educating what natural perceptions we had of good form and color stoutly maintain that arms ornamentation should be left to an artist. Some of us whose youth was spent in pursuits more immediately lucrative and who now aspire to model and draw and color, to carve, engrave, inlay and gild, are inclined after viewing the results to say the same in even stronger language. There remain those of us who haven't, but would, and those who are keenly curious as to how the other fellow does it. And lest we go astray in our attempts to beautify and, instead, produce effects weird and disturbing; and also lest we fail to appreciate a good thing when we see it, perhaps a bit of preaching may not be taken amiss.

Before attempting any handiwork intended to express sentiments or aspirations a technician learns during his period of training what the masters have done in all ages, because culture of the present has for its base the sum of all that has ever been done. In the days of old sculptors lent to arms their superior

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skill in creating forms that were beautiful; painters, their cultivated taste in color harmony and contrast; goldsmiths, their best knowledge of inlaying, enameling, engraving and encrusting. We are not equipped to invade the realm of art until we know what already has been done, and, if possible, the reasons why.

Excellent specimens of richly ornamented ancient arms exist in many public and private collections in America; we can turn to these sources for understanding and perhaps for inspiration for producing modern arms with grace of form, appropriateness of shape to purpose, glamour of color and symbolism.

Such specimens conform to the general rules of art. In mass there is a principal part, a secondary, and subordinates, all merged into a whole. They are not, like a modern rifle, divided into constructive units by a butt and fore end separated by a receiver of alien form and topped by a slender rod that appears to serve merely as a spout to the receiver with no apparent other relation to the whole. In the ancient arm the lines of the whole form are free and flowing, without grotesque lumps, or hollows that suggest weakness; and they have "movement" progressively and without apparent interruption in one direction, from breech to muzzle.

Next consider color. The ancient weapon has composition and balance of color masses, harmony of tone, emphasis in the right places by contrast of minor effects, variety in abundance, yet all subordinate to the effect as a whole. The modern arm is liable to have a butt of one color and graining, a

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fore end so different that it appears not to belong, and these and the monochrome metals are usually inharmonious. It is as if the designer — if there is such, nowadays — said, "The gun may be used for fighting, therefore have its parts fight to keep it nerved-up." We are the ones that the hideous instrument keeps nerved-up. We must abandon illiteracy, so to speak, in form and color of our sporting arms. We are on the verge of a change in rifles as great as between muzzle loaders and metallic cartridge magazine repeaters. A few years more and a new era will be on; our new arms must embody the rules of good taste that the sculptor and the architect, the painter and the decorator know to be the fundamentals of beauty. Our expressions represent us. Today we are expressing ourselves as mere machines.

Next consider applied form as pertaining to arms ornamentation. Applied form includes any shapes added to the original mass solely for the purpose of adornment, and includes carving, embossing, engraving, inlaying, and such. The applied ornaments of a beautiful antique weapon were chosen for shape or pictorial meaning appropriate to a firearm. We never find a first-class old gun decorated with representations of holy subjects, or cupids, Venuses, hothouse flowers or lap dogs, because of lack of connection. But we do find shooting and sylvan scenes represented in the flat — that is, without much perspective — and spirited representations of the fauna and the flora that belong to the out-of-doors where

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the arm itself belongs, not strongly realistic, however, but correctly conventionalized; and we find abundant geometrical work designed for beauty of line, and often serving at the same time to tie together the more important ornamentation.

In ancient Japanese arms applied ornament was not only ornament but also symbolism, and conveyed to the owner of the gun suggestive topics of pleasurable, moral, philosophical, or patriotic musing in periods of rest. Thus the gold, silver and copper inlays on stock and barrel could be read in procession from breech to muzzle and suggest one train of thought, and, reversing, another; and by a wealth of variety in the details of picturing, read and understood more commonly than the alphabet, wide variety was given to the meaning. To illustrate, consider what could be done with such simple means as these:— a carp surmounting a waterfall or rapids signified agility, perseverance, success; a lion, strength, valor, chivalry; a cherry blossom, beauty, poetry, patriotism; a pæony, prosperity, wealth; a pine tree (evergreen), long life, immortality. Dragons, clouds, volcanoes had such wealth of meaning according to their kind and the varied methods of picturing that they in themselves told whole stories. In ornamentation of this kind, using subjects not themselves pertinent to arms or feats of arms, the Oriental mind nevertheless worked by the same rules of art as the Occidental because of the meaning of the symbols.

In ancient European arms symbolism was con-

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fined closely to forms adopted by armorers, artists, guilds, towns, and leaders of noble birth. The kind and arrangement of the ornamentation told a tale to those skilled in its reading, always pertinent to arms, war, the chase, or somebody or something corelated. Quite subordinate to the general principles of design come the mechanics of art-handicraft.

Wood carving. Cover the part, flat or curved, with paper and mark on the paper the outline of the space to be carved; on the wood locate accurately the angles of the outline drawn upon the paper. Remove the paper to a drawing board and draw the design with care, and it is well to indicate with shade lines, or by blocked-in background, the high and low surfaces. To the back of the paper secure carbon paper and once more attach the paper to the wood, the carbon side being against it, and the corners located by their positions previously marked. With a hard pencil go over the lines of the drawing. Upon removing the paper the drawing will be found transferred to the wood. Lay the drawing where it will be in view for reference while carving. Fasten the wood to be carved so that moderate force will not move it but so that it can be turned completely around a circle; for this a swivel vise is almost a necessity. Use regular carving tools and keep them constantly very sharp. Cut with the grain and across it but never against it; turn the wood as often as necessary so that every cut will be made away from you or across, not toward your body. Other

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than data so obvious to every mechanical mind as these, little worth-while written instruction can be given; carving depends for pictorial effect entirely upon light and shade and shadow; nothing but practice and experience, taste and judgment will differentiate bad from good results.

Inlaying. Whether wood is inlaid with other wood or with ivory, mother-of-pearl, metal or what-not, the method is the same. First the generalities will be considered, then the principal details that cause the amateur trouble. The inlay must first be cut to the correct outline. Then, if necessary, convex or concave the under side to conform to the surface into which it is to be set. Bevel the edge all around slightly, the purpose being to cause a final tight fit by wedging. Fasten the inlay in position with adhesive or with string and cut a light line around it into the wood, slanting the cutting tool to agree with the bevel. Remove the inlay and cut out the wood within the outline, beginning in the middle and working towards the edges, gaining the necessary depth and width with many light cuts, never with deep forcible ones. Deepen the outline before excavating quite up to it, using for the cut a pointed, narrow, and thin blade. When the depth of the excavation equals within a hair's breadth the thickness of the inlay, set the latter in place and squeeze it partly in, noting whether upon removal corrections in the outline or depth of the cut are necessary.

The means to secure the inlay when it is finally

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seated are screws, pins, blind pins, adhesive. Holes for the two former are bored through the inlay after it is finally seated. When an inlay is already provided with blind pins the difficulty, in the very beginning, of locating it exactly right is greatly increased. The custom is to locate it with one hand, the eyes being directly above it, and with a small hammer in the other hand tap it lightly so that the points of the pins dent the wood. Convert the dents into holes, drive the inlay down to the wood, mark around it, and proceed as before. In the rare event of needing to set a new inlay into an old excavation already provided with blind pin holes, cut the inlay first to fit the excavation; drive pins into the holes, not quite flush; touch their projecting tops with paint; press down the inlay to receive the paint marks; remove the inlay and the pins; prick-punch the inlay in the centers of the paint marks; clean inlay and pins of paint; brush punch marks and pin tops with soldering flux; heat inlay; apply a tiny drop of solder to each punch mark; touch the pin top to the melted solder and it will stick. Before setting a blind pin inlay finally in place a good workman will make sure of the holding quality of the pins by barbing each pin in several places. The adhesives commonly used are melted shellac, iron glue, and rubber cement. When using rubber cement — the identical article used in fastening rubber heels to shoes — coat both the surfaces that are to be together and let the cement become almost hard before driving the inlay into place; if the surfaces are

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united while the cement is liquid the adhesion will be weak and imperfect. The last step in the fitting of an inlay is filing and sandpapering its surface projections to conform to the shape in which it is set.

The foregoing deals with thick inlay. If thin material cut from sheet metal, ivory, ebony, etc., is to be set in a curved surface, cut a sizable piece from the sheet and bend it to conform to the curve of the surface before cutting it to shape. Bending may be troublesome. Dry ivory or wood will have to be softened first, the latter with boiling water, the former by immersion in hot weak acetic acid, unless a yellow tinge is desired, in which case hot cider vinegar is used.

No means have yet been found for softening mother-of-pearl without dimming its iridescence, hence for curved surfaces use thick pieces. Soft sheet metal causes trouble in bending only when it has to be fitted to compound curves, in which case outer and inner forms may be necessary. For instance, make a hard solder cast of the curved surface, using solder cool almost to the stiffening point and removing it from the wood before it causes discoloration. Electroplate it with copper to get a hard surface. Line it with paper of the thickness of the metal. Using the paper lining for a surface, make another hard solder cast. Bend the sheet metal with the fingers to an approximate curve, first if necessary drawing its temper with heat, and press it between the forms. Then, if its outline already marked upon it cannot be cut with scissors, use a jeweler's saw.

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If the outline is made up of delicate parts, such as leaves, tendrils or other nearly detached shapes, before these can be cut the material may need a backing; melted sulphur spread an eighth of an inch thick on the under side and allowed to cool there sometimes serves excellently as a stiffener. Cut through it with the saw.

Silver wire scrolls and diaper pattern inlay in wood, now a lost art, has a charm of its own unrivalled by any other ornamentation of its class, and should be revived.

Metal carving, embossing and inlaying. For elegance of design in cut steel and iron refer to Italian and Spanish arms of the 17th and 18th centuries. For admirable perforated work in brass refer to the patch box plates of the best Kentucky rifles. Perforated work, foreign or American, classifies under two heads, that in which the fanciful metal outlines form the ornament, and that in which the perforations are the shapes for which the metal work serves as a frame. Only a designer of great ability should attempt to combine the two in one design.

Before attempting work upon steel or iron anneal it. Cutting is done with saws, punches, drills, chisels and files. The chisels employed are usually driven with light taps of a small hammer instead of by the strength and skill of the wrist and arm as in wood carving. Files, coarse and fine, are needed in great variety of size and shape: rat tail, half round and segmental, flat, square, and triangular of many shapes.

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Metal coloring and inlaying. Steel and iron can be surfaced with any color or colors through the medums of heat and chemicals. Small spots brilliantly polished and then colored red, blue or yellow give the effect of jewels. Larger areas of strong color may be gained by inlays and by plating. To inlay gold, silver or platinum undercut the sides of the excavation, or drill a number of small, shallow, slanting holes, to serve as fasteners. If molten metal cannot be used for a filler, build up the excavation with sponge metal as a dentist fills a tooth, and with a dental hammer. Electroplating with gold, silver, copper, etc., requires too bulky and expensive an outfit for one not in the business, but the amateur can secure as good results by applying to the surface a coating of the powdered metal mixed with mercury and then evaporating the mercury with heat; this was the method used by gilders up to about 1840, when the cheaper and quicker electroplating process caused its disuse. The amateur metal worker and plater would best avoid attempting to represent animated forms and instead utilize the decorative conventionalizations of Solomon's-seal, holly, hawthorn and laurel.

Engraving and etching. As the engravers' art comprises in addition to artistic ability a high degree of manual dexterity attained only after long practice, the beginner, in ornamenting with incised lines, would better do the cutting with acid. After the design is drawn on the metal, the work with acid is under good control, while hand work would not only

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be crude in line but also full of imperfections due to slips and runovers. Only brief directions for engraving with acid need be given here because they can be supplemented with entire books on the subject from public libraries and better yet by personal observation of the materials and methods of professionals, who may be visited in any city. Clean and polish the metal to be engraved; heat it to about 100 degrees and brush on a smooth, thin coat of dragon's blood dissolved in alcohol. Smoke the coat. Lay on it, and fasten, a tracing of the design previously blackened with pencil on the back. Go over the tracing with a hard pencil and remove; on the smoked surface the design will show in silvery lines; draw the design through them to the metal with a sharp point. Build a dam around the design with wax to form the sides for a pool of acid, or, if the metal is a small piece, coat all of it but the design with dragon's blood and immerse in acid. Nitric acid and water, half and half, will do, although etching fluid would be better. As soon as the light lines of the design are cut by the acid, coat them to stop further action and re-immerse; repeat until the broad and deep lines are satisfactory.

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Part V

MAKING RIFLES THE MODERN WAY

Adjacent to navigable water and a large railroad is a country town. Its sleepy existence is aroused by rumors and then thoroughly awakened by the influx of an army of workmen. A score or two of glass, steel and concrete buildings, each about 60 by 600 feet by four stories high, begin to grow; the town's main streets run between them; they are connected by bridges at the third story and, in groups, by their own concreted surface roads. From the railroad spur lines are run into this "plant," and along its water-front wharves and tramways and coalsheds seem to spring up over night. Machines, bewildering by their many kinds and countless numbers, are installed in the buildings.

The inhabitants of the town are agape at stories of lawns, gardens, shrubs, trees, restaurants, libraries, hospitals, growing at the plant; and at the pay that is offered. They apply for work almost to the last one, and all are taken. Every day the railroad brings hundreds of strangers to the town; the plant absorbs them. The little town grows fast with new streets lined with new houses built with the money of the plant; the town is its own no longer; it is the town of the plant.

Vast riches of materials come in constant procession — blocks of walnut, bars and rods of steel, pigs

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of spelter and copper, ships' cargoes of explosives, countless other things. The plant is so designed that each raw material is stored at the beginning of its journey along the road to becoming a finished part, and all finished parts meet where they are to be assembled, and nothing retrogrades during any part of its journey.

But we who follow the making of a rifle have to go forwards, and backwards, and crosswise, because we have to journey to the same end several times, each time by a different route. In the brief time at our disposal we will first see a stock made from a rough piece of wood called a blank. We will follow the blank until the finished stock reaches the assembling department and then go back and across to the bar steel storage house and follow a slab of steel until it becomes a finished frame and is joined to a barrel. From there we will go to the source of the barrel — the storehouse of steel rods — and follow until the finished barrel meets the finished action and both go to meet the stock in the assembly department. Meanwhile we shall have had glimpses of the making of the parts of the action mechanism, the hand-guard, the bayonet, and the furniture; but however interesting their manufacture is to a technical man, to the general public they do not have the romance of stock and barrel.

First we go to the wharf or siding to see the blanks unloaded from boat or train. They are fresh from the mill where they were sawed, roughly, so as not to exceed specified dimensions. They are in bundles

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of 100, each bundle weighing 800 pounds or more, so the bundles are handled by a traveling crane which picks them up and swings them onto a railroad flat-car, which conveys them to the drying kiln. There the bundles are counted, opened, inspected, and the blanks stacked in a kiln. Kiln after kiln is filled, closed, and the steam turned into its radiators, until perhaps ¼ of a million embryo rifle stocks are being sweated of their moisture.

As they will have to stay much longer than we can wait, we pass along to other kilns which are open because they are full of blanks which are dry. These dry blanks are being stacked into cubes, on a platform on an elevator; the elevator raises them one story to the mouth of a chute inclining downward and reaching to the sawing room; a man with a pole pushes a platform loaded with blanks into the chute, and gravity makes them travel.

From the first operation on the blank in the sawing room to the last in the assembling department there is general uniformity in the method followed by different plants and in the machines employed, but there is a wide difference in detail. It is possible for a plant to make stocks — hand guards and bayonet handles not included — with a series of thirty-two machines made by the Defiance Machine Works. But although all plants use more or less of these machines, no large plant constantly uses an entire series, because each chief of a stocking department has his own program for a gun stock to follow, and claims that his way saves handling, which he claims

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is equivalent to money. This should be carefully investigated by the Time Study Department and checked by an expert, for a great deal of money can be wasted upon the fashioning of a stock. The blank that we are watching will follow an average route.

In the sawing room a man at a planing machine picks up a blank delivered directly to him via the chute and runs both sides quickly over a planer to remove humps. He passes it to a band saw operator, who slices surplus wood from the edges, at the same time truing the shape by eye as well as he can. He passes it to a circular saw operator, who cuts the top edge of the barrel-bed straight. The blank now has for the first time a true surface from which, as a starting place, any measures may be laid off. The next operator to receive the blank is the equalizer, who lays it flat on a movable bed, with its straight edge against a directing edge and the checks (cracks) in its ends projecting according to their depth from the sides of the bed, and by means of a treadle raises the bed with the blank firmly fixed on it against two circular saws, which cut off the ends, both at the correct angle, and leave the blank cut to the right length for turning; then, by moving a lever, he bores two holes in the butt end and one in the tip to serve as centering and holding points for the turning lathe, which comes next.

So far, all operations have been of the most ordinary descriptions, one's interest centering only in the speed. The series of machinings which terminate

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the making of the stock are of even less interest to the public, but between the beginning and the end there are two kinds of machines which are wonderful to everybody; these are the multiple spindle machines and the lathes for turning irregular forms; we come to the latter first.

In olden times such irregularly-shaped articles as axe handles, shoe lasts and gunstocks were made by hand, and the process was slow. But, according to legend, one day Thomas Blanchard, born in Sutton, Mass., celebrated already for mechanical ingenuity, walked into Springfield Armory and asked for a job. "Don't need anybody," said the foreman. And then "That's a queer-looking hat you're wearing." "Yes," said Blanchard. "It's wood." He took it off and handed it to the foreman. The latter inspected it carefully. It was oval, like a Derby, and with curling rim. Around the outside a half-inch band caused by the marks of a tool showed faintly, winding an even spiral from crown to rim. "Make it yourself?" asked the foreman. "Yes," replied Blanchard, "turned it on a lathe." "Impossible," replied the foreman, "no man ever yet found a way to turn an oval on a lathe. Why, if you could do that you could turn gunstocks on a lathe, and make your fortune." "I can do both," answered Blanchard. "I've just patented such a lathe. Want to buy a few?"

Gunstocks and such have ever since been made on irregular lathes, not quite so crude as Blanchard's first, but never improving on the main idea. And

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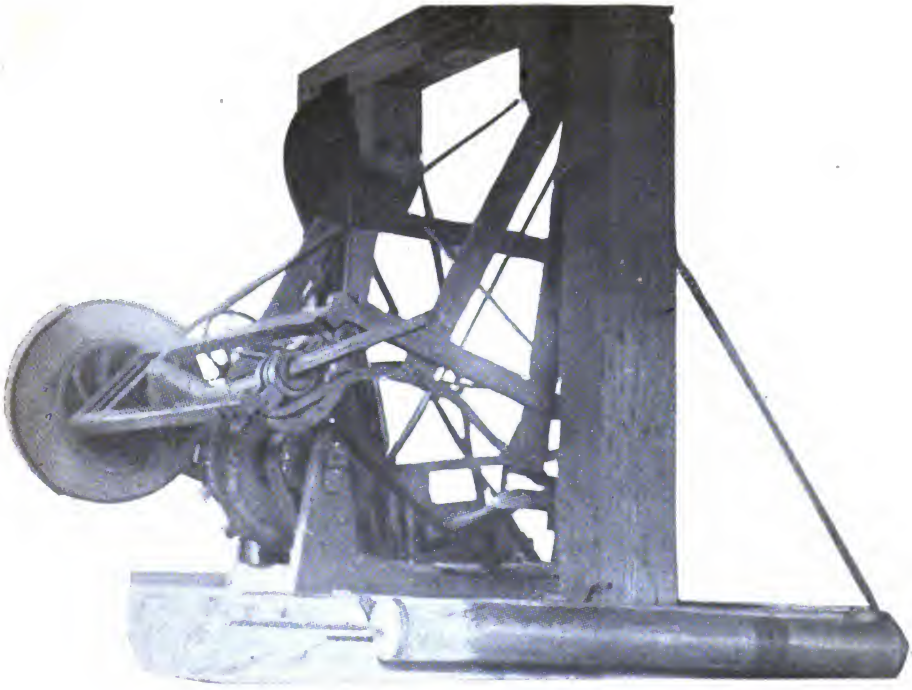
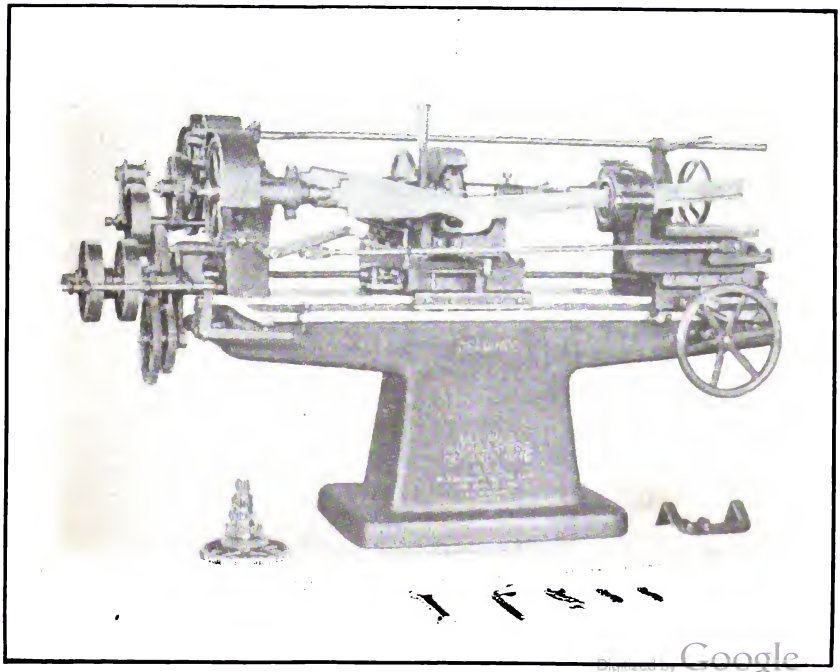


The Original Blanchard Irregular Lathe



Modern Irregular Lathe

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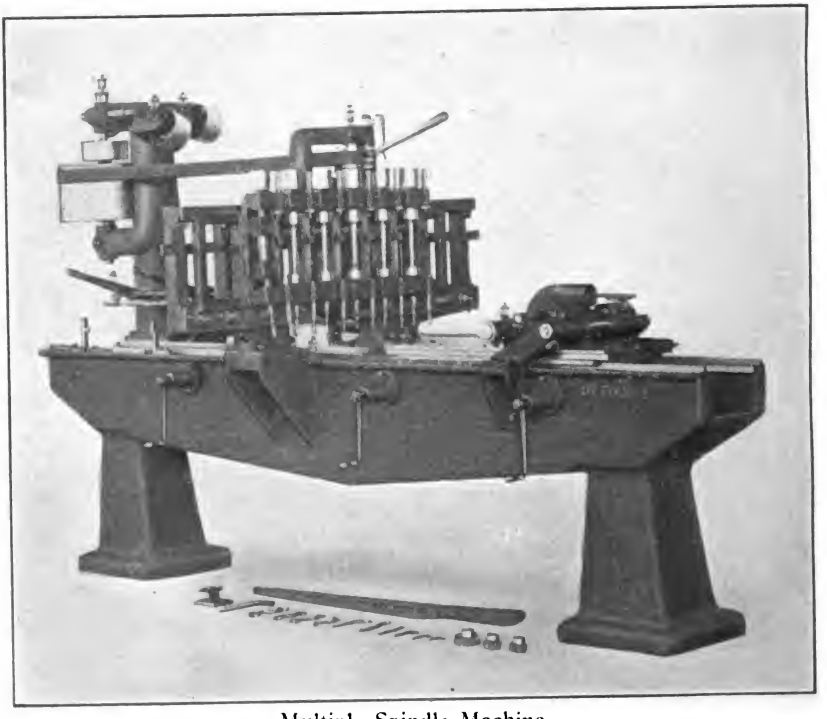

Multiple Spindle Machine

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this is how the trick is done. In a common lathe the wood turns but the cutting tool is fixed. In the irregular lathe the wood turns and the cutter both revolves and moves otherwise, controlled by a metal model of the gunstock. The cutter revolves to cut and it swings back and forth to cut high and cut low, guided firmly by the model in its work upon the shape of the blank; and the machinery of the lathe moves the cutter also steadily sideways, constantly in touch with the model behind and the blank before, until it has cut the blank to conform with the model from end to end.

Now we see why the holding points in the ends of the blank were necessary, and also why, before they were bored, there had to be a true surface from which a machine could reach to locate them.

The first irregular lathe into which the blank is put shapes the blank only as far as the rear band, and roughly, at that, leaving all dimensions perhaps quarter of an inch greater than they will be when finished. After the first few lathes and some minor machines have worked upon the stock it goes to the first of the multiple spindle machines. One of these machines carries a lot of tools. The stock is clamped in place and the machine goes ahead like a human being and uses each tool in succession to completion, and does as much work in a few minutes, and at least as accurately, as a man could do in as many hours.

Finally the gunstock comes from the machines completely shaped and with every cut and every hole

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exactly like those of every one of its mates; and, stacked with twenty-five to fifty others in a rack on an electric truck, it goes for a bath of several hours in hot linseed oil. After it has absorbed about quarter of a pound of oil it goes to the staining room, where its streaks of sapwood are toned to match the rest of it. Of course it would be better to stain it first and oil-soak it afterwards. Then it goes to the filling room, where the pores of the wood are filled flush; and from there to the assembly department, where the barrel and action and furniture are waiting to join it and make a complete gun.

Now we take an elevator to the ground floor, and then an electric motor truck, and go again to wharf or railroad, to see the rough and perhaps rusty bars of steel from which frames and other parts of "a stand of arms" are to be made. These pieces of metal go first to the steel storehouse, from which they are requisitioned, by written order, as needed. But first samples are sent to the laboratory to be tested for composition, structure, homogeneity, etc., in order that the plant may know that it is getting what it ordered, wants, and is to pay for. If correct, the bar steel is cut to sizes wanted, and the pieces, all of a kind together, annealed, that is, softened by slow heating, so that they can be worked upon by machines easier and faster. We follow a rectangular chunk of steel, weighing perhaps ten pounds, from the annealing room to the first machine shop, where we see a planer cut a true surface on it for the same purpose that the wooden blank was trued along its

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top edge. Then it goes to a horizontal boring mill and is partly hollowed out inside. Then it goes to drilling machines, spindle and turret lathes, millers and grinders, until it is true to size and shape inside and out.

But, interesting as some of the complicated lathes are, and wonderful as is the work they do, nothing along the route of the frame is so interesting as the guages which make certain that it will come from the last machine true to size and shape inside and out. These guages or measuring instruments are often large, complicated, and beautifully finished, and the wonderful accuracy with which they are made so far surpasses average human credulity that it may not be best to state just how close to the ten-thousandth part of an inch a skilled guage-maker can work. And the first set of these guages was made before any part of the rifle was, in the guage, tool and die shop within the plant, from blue-prints furnished by the draughting room, which were made from sketches and calculated dimensions furnished by the Engineer Department by direction of the chief. So it is evident that somebody needs to know a good deal about arms production and have a very capable thinking apparatus too. Meantime, what has become of that frame? It has gone to the tempering furnaces to be made sufficiently hard and springy. From there it goes to the "browning" room to be colored like the barrel; and we will omit that now because we shall see it there when we follow the barrel on its long journey.

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Next we go to the rooms where the many pieces that go together to make the " action " of the rifle, inside the frame, receive their final inspection as separate parts and are assembled and put in place. If many pieces of a kind, large or small, have become crooked by heat treatment, or break too easily, the fault may lie in the structure of the steel; and to determine if that arose from some fault in the manufacturing processes prior to heat treatment, the piece of steel is given an etching bath, which brings out in relief all flaws, faulty welds, cracks and seams, and also shows plainly the direction of the grain. The solution is composed of 9 parts of water, 3 parts of sulphuric acid, and 1 of hydrochloric acid; in this bath the specimen is boiled twenty minutes and then washed with water. The specimen is then critically examined by those technicians capable of judging it; and if very odd in appearance it may be hung in the inspection department as a curiosity and a warning. And that takes us to the door of the assembly department, where the whole gun is put together, so we turn back once more to begin at the beginning of a barrel.

The origin of a barrel is a steel rod. It may be an inch or more or less in diameter and twenty feet, or more or less, long. As received by the plant from the steel mills, probably in Pennsylvania, it is supposed to be made of pure iron and a little carbon, silicon, nickel, chromium, sulphur, tungsten, all of them or more likely part of them, according to what the plant ordered. Samples of the rods go to the laboratory for analysis.

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We follow a rod from the storehouse to the cutting-off room, where a ponderous machine shears off even lengths six inches or more longer than the finished barrel will be. Then to the forge shops, where one end of the piece of rod is heated to redness and thrust into a machine that takes it by the cool end and by pressure upsets the hot end; this upset — i.e., shortened by thickening — end is to be the breech of the barrel. The piece of rod is then a barrel blank, and goes to the " quenching shop."

The blank next goes to the straightener, who revolves it slowly by hand in a crude lathe, marks the convexities, straightens the blank, and spots the center of the breech end with an indentation. From him it goes to the vertical boring mill.

The variety of vertical boring mill designed especially for barrel boring is attractive and mysterious looking to the uninitiated, and a series of mills — perhaps a dozen, arranged side by side in two groups with an operator in the aisle between, strongly resembles the engine room of a steamboat in machinery in view and lack of visible evidence of what it is doing or how it does it.

The operator stops mill No. 1, and drains the oil. He opens the door to a cylindrical box standing on end, takes out the bored barrel, stands it in a rack, takes a blank from another rack, and thrusts it, muzzle end first, up inside the cylinder until it nearly disappears from sight. Then he picks up the drill and shows it to you. It is slightly longer than the blank, slender, shining, has a deep crease along

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its full length, is hollow inside, is very sharp at the point (which is made of special steel brazed on), has a chunk of metal on its other end, and a hole clear through it from the outside of the chunk to the tip of the point. He puts the drill, big end down, into the bottom of the cylinder and raises it until the point engages the indentation in the breech end of the barrel blank, adjusts it carefully, closes and fastens with a cam-latch the door of the cylinder, turns on the oil, and starts the machinery. The lubricating oil, under pressure varying from a few hundred pounds to a ton to the square inch, pressing on the bottom of the chunk (called " float ") at the bottom end of the drill, forces the drill hard against the steel that is being cut, and, squeezing in a powerful stream through the hollow drill and out at the hole in the point, lubricates the cutting end and washes the steel chips down the deep crease along the drill out of the hole that is being bored in the barrel blank into a catch basin below the cylinder. The mill turns the drill one way and the barrel blank the opposite way, and if the steel of the blank is homogeneous the drill will follow the axial line of the blank and emerge close to the center of the muzzle end; but it rarely is and the drill rarely does.

Meantime the operator has loaded mill No. 2, No. 3, and so on until his entire series is going at once. By the time the last one, perhaps the dozenth, is going, mill No. 1 may give the signal that its work is done. The time for boring a barrel may vary between a few minutes for a short, soft one, to half

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an hour for a long hard one. Call it fifteeen minutes, which is quick work for the blank of a Model 1917 U. S. Military Rifle.

From mill No. 1, the operator takes the bored blank, now for the first time eligible to be named barrel, marks it with a red pencil so that we may identify and follow it, puts it in a rack with 25 or 30 of its fellows, and sends it to be fired with a heavy proof charge. From the proving room it goes to straightener No. 2.

Straightener No. 2 has before him a block — or a bench — on which are lying two pieces of iron, side by side, but nearer together at one end than at the other. There is also on the block a hammer, weighing two or three pounds, of soft iron or perhaps of antimony or even copper. The straightener looks through the barrel at a window across which a rod is fastened. He says to you " Huh! that blank had lumps in it. Hard place there, soft spot there, hard one further along; see for yourself how the drill dodged around the hard places and what a crooked path it made." You point the barrel to the window, see the bar, lower the barrel a trifle until you can't see the bar through the hole, and two dark lines appear along the sides of the bore. The bore not being straight the lines are crooked. They are both the symptom and the test of the deformity. You slide one hand along the outside of the barrel in the attempt to locate the crooked places; you can't do it and you give the barrel back to the straightener. He takes it with both hands, the right

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one at the breech and the left one half way along, looks through it, lays it across the pieces of iron on the block, hits it a blow with the hammer, looks again, hits a blow in another place, looks again, and passes it to you. He spent perhaps ten seconds. You look. The shade lines now are straight. You marvel at the straightener's skill. Small matter, and quickly acquired.

Not all barrels come from the mill as crooked as this one, but, in a thousand, nine hundred and ninety-nine would be out of true to some degree. It is questionable whether straightening military barrels is worth while, because the straightened barrel is not normal in its atomic energies, and, under the influence of vibration caused by a fall or a blow, or of heat caused by rapid firing — and a military barrel is much abused with both — the straightened barrel usually reverts to the atomic structure that it originally had and takes again the boring mill crooks in its bore. It will, with crooked bore, still shoot a series of shots accurately at a given distance with a given sight-setting, but for any other distance it needs a double readjustment of the sights.

From this time on, the sequence of operations which perfect the barrel varies in different plants; in this imaginary plant we follow the barrel next to a lathe where the breech and muzzle ends are machined to size and to concentricity with the bore. In some plants the entire length of the barrel is machined at this stage. Next, it is inspected for any

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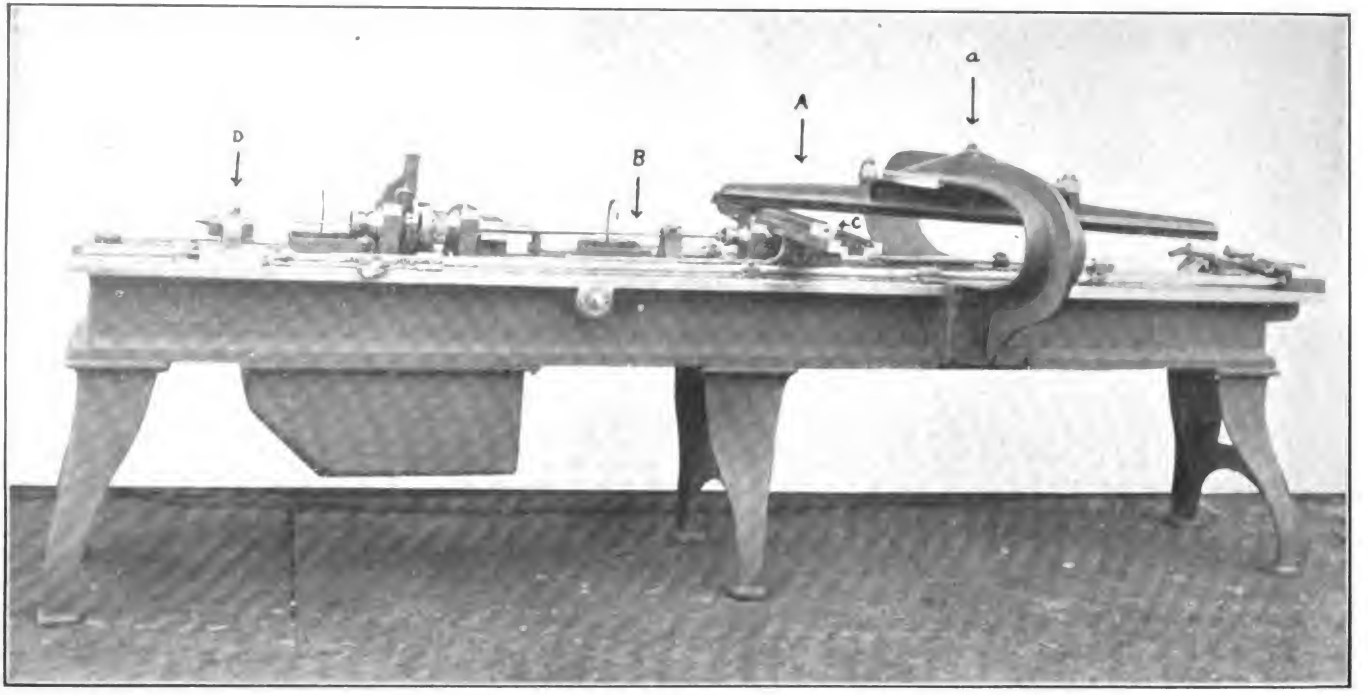

A Modern Rifling Machine

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crookedness that may have been given it in the machining process.

In the many operations which are to follow suppose we select only the spectacular ones as being of general interest. The next operation is fine-boring, which is done on a lathe with a tool quite different from the one that, in the boring mill, cut the first rough hole. The object of fine-boring is to make the bore true in diameter from end to end, and of the correct size.

Chambering comes next, and is done on a lathe, barrel horizontal, usually with a series of borers and reamers, but sometimes with a single tool.

Then the barrel goes to the rifling machine. A modern machine, made by the Pratt & Whitney Co., is shown by the picture. The barrel is held by the wide-jawed chuck and is compressed as little as possible. The arm A can be swung on its pivot A to make an infinite number of angles with the direction of the movement of the cutter rod B, and so cause the traveling slide C to vary the number of times the rod rolls on its long axis during its movement along the inside of the barrel; and that is what determines the pitch of the rifling. First the operator runs the cutter rod through the barrel, leaving both ends sticking out of the barrel; then he puts barrel and rod in the wide chuck. They show in the picture. The breech end of the rod he slips into another and smaller chuck, the one which is to operate the cutter rod. The other end of the rod sticks out of the muzzle, and to it he fastens the cutter-head.

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Then he pushes the cutter-head back until the rear part of it goes into the muzzle, and the cutter itself is, according to his judgment or the set of the machine, the right distance out. He moves the sliding receiver D along until it touches the cutter-head and fastens the receiver in that place. Then he steps to the breech of the barrel and fastens the chuck upon the rear end of the rod. The machine starts. It pulls the cutter backwards, through the barrel, and turns it at the same time, so that the cutter makes a pathway, perhaps one five-thousandth part of an inch deep, or even one-thousandth, winding in an even spiral from muzzle to breech. When the machine runs the rod forward the front end of the cutter-head encounters the receiver, is gripped by it, and turned, causing a screw, or a wedge, or both, to raise the cutter itself enough to take off another shaving. Then the machine pulls the rod back, causing the cutter to deepen the pathway. The operator holds his hand at the breech of the barrel to receive the shaving, and by the feel of it he judges whether the cut is being made right, or too shallow, or too deep. When the machine has run the rod back and forth as many times as the operator has set the dial for, the machine turns the rod or the barrel for cutting another groove, and stops of itself so that the operator may lower the cutter for a new first cut. It wouldn't be a bad plan for the machine to do that, too.

We follow the barrel into the next room, where it is put again into a rifling machine, this one of an ob-

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solete type, to be leaded-out. Near by a man at a furnace, with a kettle of molten lead before him, a pile of slender rods beside him, and a rifle barrel in his hands, is busy making "leads." He winds a rod, just back of one end, with a wisp of tow, runs it into his barrel to within six inches of the muzzle, holds the barrel upright with one hand and with the other pours in some molten lead. Then he pushes out the rod with the lead firmly fixed on it. If he has done a good job he has a perfect cast of several inches of the inside of the barrel. He lays the rod on a pile of its fellows.

The operator at the machine selects a cool one, runs the rear end of the rod into the muzzle of the barrel and clear through it, starts the lead into the muzzle with his fingers, brushes the projecting part of the lead with a thick mixture of oil, graphite and flour of corundum, fastens the rear end of the rod in the chuck of the machine, and starts the machine. Each time the movement of the rod thrusts the lead beyond the muzzle, the lead gets a new and even coating of the scouring mixture. For leading this barrel and others of its kind the operator allows six movements of the rod, and no more.

This leading-out has been done right, but usually it is done wrong. The object of leading-out is to remove any burrs that are within the barrel, to improve, if possible, the evenness of the diameter, and to smooth and polish; in short, to add the last finishing touches that make for perfection. But the operator may spoil a barrel much more readily than

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he may improve it. The leading-out operative is a much more important workman than he is now recognized to be. Upon his knowledge, but especially upon his faithfulness, the accuracy of the barrel is absolutely dependent; and if he is an unreliable workman he negatives all previous care and good workmanship that the barrel has received. A typical, common case of bad leading-out, for which not only the workman but far more those above him are responsible, is as follows. The helper at the furnace does not take pains to center each rod in the barrel in which he casts leads, so that in some cases the rod is exposed all along one side of the lead; in another case the rod runs diagonally in the lead; all his leads are honeycombed, misshapen, and untrue. He throws each newly leaded rod haphazard toward a growing pile of them; and the machine operator fishes out cool ones from the bottom of the pile, drawing them out and raising them by holding to the lead and therefore bending the lead to any degree between a little and a right angle or more. He knows that the power of the machine will yank the lead into the barrel, no matter how great the bend; and the machine does, and in doing so wears the muzzle at one side more than at the other. The lead being also imperfect from faulty casting, more of one side of it than the other will be in contact with the inside of the barrel, and that larger side, having more gritty surface — and corundum is very sharp and hard and scours fast — causes the inside of the barrel to become ovaled. The operator talks, tinkers,

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walks about while his machine works, so that barrels get scoured far too much, and some more than others. In consequence, all barrels that go through his hands are ruined, and when they are tested on the range of the plant before being sent to the soldiers at the front, they all fail to make good targets, many of them, at ranges beyond 200 yards, fail to hit even the butts. The range men often are paid according to the number of rifles that they pass; hence they may not condemn those rifles, but instead lay the blame to the ammunition. In fact in every plant the superintendent of the ammunition department either says that he is the office cat or else that he leads a dog's life.

After our barrel has been leaded out it may go to an inspector, who sees if it needs a final straightening. If so, the straightening is done with a machine, elevated to the level of the straightener's head, having two holding fingers and one thrusting thumb midway between them, operated by a heavy wheel.

The barrel now is shaped, bored, rifled, chambered, countersunk, threaded; has received the extractor-cut, sight slots, and every other machine operation, and all necessary inspections; but it isn't finished, because it is " in the bright." In order that when in use it may not rust easily on the outside, and that it may not glimmer in the light, its exterior needs to be coated. The process is called " browning "; but as the barrel when finished will not be brown, the term is a poor one and should be discarded. It is at present a chemical process, but in time better and

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more rapid work will be done by galvanic oxidation, or perhaps plating.

The browning shop is divided by the nature of its work into four parts: the receiving end, where our barrel and our frame arrive; the application room, where the oxidizing and coloring liquid is applied; the heat room, which hastens the action of the chemicals applied, and the stack room, where the finished work is stacked for removal to the assembly department. Every browning shop foreman has his own private formula for the chemical mixture that he uses, and the absurd secretiveness with which he guards his formula is amusing to the layman and ridiculous in the extreme to the expert.

At Springfield Armory our government employees formerly did not use a chemical mixture brushed on, but " browned " their steel by the Buffington process in this way: — into a large iron pot, open to the air and heated from below, are put 10 parts of potassium nitrate and one part of black oxide of manganese, totaling perhaps 200 pounds of mixture. The steel to be " browned " is suspended above the mixture in a large wire basket attached to a wire rope over a pulley for raising and lowering. When the temperature of the mixture is sufficiently high to cause quick ignition to a pinch of sawdust thrown upon it the basket is lowered into the mixture. For a few moments the basket is raised and lowered in quick succession to burn off the oil that was on the steel; then it is left in the hot mixture 3 to 5 minutes, depending upon the size of the steel. After attaining

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a satisfactory color — determined by inspection — the steel is plunged into hot water to dissolve what nitre is adhering, and then into oil. After being drained of oil they get another hot water bath; when dry they are wiped with oily cotton waste.

But in our imaginary plant the color will be produced after this general scheme. The steel is freed from oil either with lime or carbon-disulphide; then coated with a mixture of alcohol, ammonia, water, nitric acid, corrosive sublimate, sal-ammoniac, and sulphate of copper. The piece of steel then goes to the heat room, where it remains in a temperature of perhaps 200 Fahrenheit and humidity, perhaps, 40, for several hours. The coat of rust thus produced is removed with steel wire brushes and the piece of steel goes through the same processes, perhaps twice more. At the end of the third brushing with the steel-wire wheel-brushes it should be evenly colored dark blue all over. If it has spots of bright steel where the chemical didn't " take," those spots are patched; if patched well they are done as the rest of the work was; if slighted, they are treated as follows: — a bright spot is wiped clean and then touched with ammonium disulphide; wiped dry; brushed with a saturated solution of copper sulphate in water until the bright spot is plated with copper; wiped; then covered with ammonium disulphide and allowed to stand until the copper plating becomes blue-black, matching the surrounding surface. This treatment takes less than a minute; it is of

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value when time alone is to be considered, because the surface so colored will not wear well.

From the browning shop we follow the barrel and frame to the assembly department, where all parts of a rifle meet and are made into a gun. A large amount of space is devoted to the workmen who fit the frame and barrel to the stock; it is rare, indeed, that the three go together right without some paring of the wood, in spite of the care with which all were made exactly like all others of their kind. The steel parts are all right, but the wood has swelled or shrunk or warped under the influence of the hot oil bath or of common every-day variations in atmospheric temperature and moisture. The main effort of the workman is to have the frame and barrel so bedded in the wood as to be, on the one hand, firmly fixed; and on the other, that the wood may touch the barrel in only two places — at the bottom of the breech and at the bottom of the muzzle.

So far in our journey through a huge rifle plant we have omitted all uninteresting details, such as provisional proof, definitive proof, manufacture of small parts, assembling of small parts, inspections, heat treatment, heat bluing, bayonet-grinding, sight setting, etc., etc. And there yet remains a joyous jaunt. We pick up an interior telephone and say to a certain official, "All ready." And he answers "The machine will be at the Blank Avenue door." No sooner are we upon the cushion of the rear seat of the automobile than a messenger arrives with a pass reading: "Admit to the range, Mr. Blankety

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Blank Blanket, Consulting Engineer. All courtesies. Obey his orders. Report."

For half an hour the machine runs rapidly further and further into the country. Wayside houses become fewer and further apart. Farms retreat into back country. Brown grazing lands and autumn-painted woods become broader and wilder. The distant range of hills, blue, dark green and violet in the autumn haze, grows more distinct. The stone walls that have been bordering the road give place along one side to an eight-foot steel wire fence. A little further along a gateway appears, flanked by a wooden sentry box. The machine turns to the gate and stops. An armed sentry steps up. He looks at the pass. "All right, sir."

Within the gate the roadway begins at once to slope; we are dropping into a valley. The chauffeur shuts off the power and coasts. Now, in the quiet, the crackling of a good deal of rifle fire can be heard. The winding road passes many concreted dug-outs — storehouses of tons of explosives drawn upon by the ammunition making part of the plant. The last turn of the road exposes a narrow and very long valley reaching towards the distant hills. It has sets of ranges, short up to 200 yards; medium, from 200 to 800; long, from 800 to 1,500. Each range has a glass-fronted house for the firing squad; butts, pits and targets; all necessary meteorological instruments, and complete telephone connections. Every clear day in the year, all the year round, regardless of heat or cold, shooting in comfort can pro-

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ceed here to determine whether the plant is making rifles or merely soldiers' guns. This is the court of last resort, for the proof of a rifle is the shooting of it.

The machine stops at a 1,500 yard range house. The shooting-master comes out. "They telephoned you were coming, sir," he says. "What will you have first?"

Within the range houses are machine rests. Each has spring clamps to permit a rifle to be set and released quickly; each has a barrel telescope with mountings that set correctly but do not fasten to the rifle — the 'scope is removed before firing — and a powerful, permanently fixed telescope bearing on the target, for spotting shots.

With these machine rests, and with tools and common and scientific instruments, and abundant man-service, the quality of the plant's service to the nation is quickly determined.

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FORWARD, MARCH !

The American Revolution and the War of 1812 proved the value of rifles as military weapons. The Civil War caused the muzzle loader to be discarded in favor of the breech loader. Our little war with Spain evolved our repeating Springfield. The World War has shown that the rifle of the future will be a combination weapon, single shot, repeater, and automatic in one. It has clearly indicated also the need of an entire change in infantry rifle training, and, moreover, the probable lines along which progress in rifles and ammunition will develop.

Starting on the base of knowledge of the past and understanding of the inadequacies of the present, we can, with the combined leadership of our civilian and military arms scientists, begin to march, first slowly, then at quick time, to a wonderful near-by future.

First, and while continuing the use of our present styles of sporting and military rifles, the skill of the trapshooter with his shotgun must be taught to, and acquired by, riflemen. The means to be employed are another story. But the need of accurate snap-shooting is evidenced by the fact that we have just been using about 7,000 shots for each enemy casualty produced. Upon our entrance into the World War, in recognition of the impossibility of marksmanship in our huge, new, non-shooting civil-

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ian army, we adopted the principle of a stream of bullets thrown as a stream of water from a hose. It produced results of a sort, using automatic and machine rifles, but it was and is too wasteful to be permanent. We must never again get caught in the fix of being nationally unfamiliar with arms. Henceforth the tendency will be toward accurate shooting with individual bullets fired by soldiery trained while civilians in snap-shooting; trained by compulsion if necessary, but trained as members of rifle clubs.

Second, concurrently, we must force the lines of development of arms and ammunition. These developments if normal will occur step by step, and if so occurring will be accepted and assimilated easier and quicker than radical changes, which always provoke strong opposition. At the same time progress may be rapid.

Rifles must be fired electrically. Five hundred years of use of the ancient trigger have more than warranted its discard. Its pull, heavy or light, disturbs the aim of any but the most accomplished rifleman. Mastery of the trigger requires a long apprenticeship. Its use intrudes an appreciable interval of time between the will to fire at a right instant and the actual explosion which occurs later at a wrong instant. Force, movement and time are to be reduced.

Rifle sights of all varieties now in use are still in their infancy. They must be magnifying, light-gathering, range-indicating; simple, protected; *multum in parvo*.

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A rifle must handle several kinds of ammunition. And ammunition must be both lighter and cheaper. To this end a cartridge shell less in both weight and cost than brass will replace the present one. Probably it will be made of aluminum-compound having a metal value about one-fifth that of brass, and the cost of work upon it with punch and die will be greatly lessened by the absence of the present form of expensive primer pocket and primer, both of which will become unnecessary with electric ignition of the charge.

Sound, flash, and smoke of explosion need reduction to the minimum, approaching zero as closely as possible. And the loud snapping sound of the bullet in flight, caused by the air-whip behind it, can be greatly reduced, perhaps eliminated, by improvements in bullet shape. As to the elimination of audible and visible qualities, perhaps the first step may be in the improvement of modern air rifles. Already in European markets powerful air rifles can be had which fire from eight hundred to a thousand times from one filling of the air reservoir; the first hundred shots are fired with pressure averaging about 15,000 pounds to the square inch; the reservoirs do not leak; the same sighting holds good for a considerable number of shots. While for target practice they would be unsatisfactory, for certain kinds of military use they could be made admirable. A soldier could carry easily a thousand bullets and an extra charged reservoir; the latter, of steel, need not weigh more than a pound.

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Projectiles will be of many kinds to suit varying purposes, all used by one arm. Ultimately a rifle will project gravity-influenced solids and composites, and also non-gravity-influenced pencils of light or heat which will be electrically corrosive at impact. Present experiments with projectiles may have to do with such as are primarily mechanically fitted for two-groove, elliptical, or hexagonal bores; the projectile and the cartridge shell — or perhaps only the head of the shell — to have the same cross section, and to be handled by a rifle mechanism which will instantly and unvaryingly serve the ammunition correctly.

Solid bullets will have stream lines and both ends pointed, and the center of gravity will lie in the forward half. Recent tentatives having been unsuccessful need discourage no ballistical scientist; the attempts were by inventors whose basic knowledge was faulty. The objectives are higher speed, lower trajectory, greater accuracy and penetration, less wind-drift, and the reduction or elimination of flight-sound.

Composite bullets will be either miniature shrapnel greatly simplified, or shot so encased as to open automatically without explosion at set distances; doubtless both.

Last, and in a haze through which we now see but dimly, is the uninfluenced-by-gravity straight line ray directed by an electrically operated rifle. How may a *ray* of heat or of ultra-X-ultra-violet electric manifestation be isolated and maintained intact as a

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destructive force? Here indeed is a problem requiring the application of many minds. "Company, attention! Arms, Electrical, and Mechanical Engineers, six paces to the front, march! Close ranks! Guide right! You are to operate as a unit. Squads right, forward, quick time, march!" And win.

Whatever the future may be, it will be in the hands of a new class of professional men. They will be Arms Engineers. And, as all there are in the world at present worthy of the name can be counted on the fingers of two hands, and as the need for many more is very great, it will be necessary to create them. There must be established in each of several of our university technical schools a chair of Arms Engineering, because an Arms Engineer cannot at present be created in half a lifetime from some other variety of engineer; the new species will require a part of the basic education of all the others and a great deal of special technical training besides.

From the Arms Engineer considered as a parent trunk will spring three branches: — the Consulting Arms Engineer, the Professor, and the Executive. Circumstances to some extent, but principally certain qualities of mind and disposition, will determine into which of these niches a new man will fit.

The Consulting Arms Engineer, proper, will be a free-lance and will have the world for his field of service. On the one hand he will win honor and revenue; on the other he will serve nations for the public good. But let no upstart youngster seek this rank and power. There must be solid foundations

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of education, extensive and intensive knowledge of this specialty, experience, and the cold judgment that accompanies maturity.

As to what the Professor will do for the furtherance of his science and for the world — that may safely be left to the Professor.

The Executive Arms Engineer will be the head of a great " plant." Probably he will outrank the others in influence and power. He will combine, as never yet, the qualities of an administrator and executive with those of the scientist. In peace times the experimental laboratory of his great arms plant will follow lines of original research under his personal direction. In time of war he will be ready to offer his country new and practical developments for standing off the enemy. At all times the plant of which he is ruler will be kept in the plastic state, so that in an emergency it may expand under government subsidy to any size. In time of war he will rule twenty to fifty thousand operatives, dispense funds supporting their families to the number of perhaps quarter of a million persons, and have as much sway over men and events as he chooses or as his mentality permits.

Through Arms Engineers there will be, as never before, discoveries and progress, not merely along lines of destruction, but, better, along lines of development in power and speed and generalities applicable industrially, which will cause nations to prosper and which will result in longer intervals of peace. There will be no " Halt !" to this march forward.

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DIRECTORY OF AMERICAN RIFLE MAKERS 1800 to 1919

A PARTIAL LIST OF AMERICAN MAKERS OF RIFLES FROM 1800 TO 1918

FLINT-LOCK PERIOD, SPORTING RIFLES

Allen, Silas, Shrewsbury, Mass., born 1775; died about 1850.
Armstrong, John, Penn., died 1827.
Astol, J. & W., New Orleans, Ia., before and after 1805.
Barnes, Thomas, N. Brookfield, Mass., born 1764, died, Bakersfield, Vt.
Barnhart, W.
Bartlett, Chenango Point (now Binghampton), N. Y., about 1800-1830. Formerly of Lancaster, Penn.
Beck, Gideon, Penn.
Beck, J., Penn.
Beck, S. ?
Best, Lancaster, Penn.
Beyers, N., ——— Penn.
Bird Bros., Phila., Penn.
Bird, C., ?
Bosworth, Lancaster, Penn. Moved away about 1805.
Boulon, W. S., Kentucky ? About 1800–1840.
Bowie, James, Natchez, Miss., 1832; slain at the Alamo, 1836.
Boyer, D., Penn.
Boyer, H., Penn.
Boyington, John, S. Coventry, Conn. End of the flint period.
Brasirus, J., Buffalo, N. Y.
Brong, Joseph, ——— Pa. ?
Byers, N., Penn., b. & a. 1800.
Calderwood Phila., Penn.
Cardis, Thomas, Penn.
Chase, Anson, Enfield, Mass. Before 1830.
Clarke, John, ——— Pa. ?
Collier, Elisha H., Boston, Mass.

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Delany, Nelson, Reading, Penn.
Deringer, Henry, Senior, Richmond, Va., about 1800–1806; Phila., Penn., 1806 until his death.
Derr, John, Lancaster, Penn. End of the flint period.
Dreppert, Lancaster, Penn. Perhaps son of F. Drippard.
Dunkle, G., Path Valley, Penn.
Ellis, Reuben, Albany, N. Y.
Emmes, Nathaniel, Boston, Mass. Before 1825.
Ernst, J., Penn.
Finch, Joseph, N. Y., N. Y. Died 1828.
Fordney, Melchoir, Lancaster, Penn.
French, Thomas, Canton, Mass., born 1778, died 1862.
Getz, Phila., Penn., before 1811.
Giles, Richards & Co., Boston, Mass.
Golcher, James, ——— Penn., died 1805.
Hall, John H., Yarmouth, Me., until 1816. See under Military.
Harris, Jason L., ——— before 1825.
Hawkins, Henry (pronounced Hawken, and by his sons so spelled), St. Louis, Mo., beginning there in 1808. Formerly in the Harpers Ferry Armory. Previously, Lancaster, Penn.
Hennch, Peter, Lancaster, Penn.
Henry, John Joseph, Boulton, Penn. (shop) Phila. (office) died 1836.
Hill, Thomas, Carlotta, Vt., before 1810.
Hillegas, J., Pottsville, Penn., about 1800–1830.
Homl, S. ?
Hurd, Jacob, Boston, Mass., 1816 to 1825.
Huyslop, R., N. Y., N. Y.
Kile, Nathan, Raccoon Creek, Jackson Co., Ohio, b. & a. 1817.
Klein, George, Penn. ? b. & a. 1800.
Krider, John, Phila., Penn., began about 1820.
Kunz, J., Phila., Penn.
Lawrence, Phila., Penn., before 1830.
Leman, H. E., Lancaster, Penn.
Leonard, Eliphalet, Easton, Mass., b. & a. 1800.
Leonard, Jonathan, Canton, Mass., about 1800 to 1820. Son of Eliph.
Ludington, Lancaster, Penn.
McCartney, Robert, Boston, Mass., 1805 to 1818.
McKim, Baltimore, Md., before 1825.
Meacham, I. & H., Albany, N. Y.
Miller, A. ?

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Mills, Harrodsburg, Ky., until about 1815.
Moll, N., Penn.
Moll, Peter, Penn., began about 1820.
Oakes, Samuel, Phila., Penn., about 1800.
Overly, Peter, Kentucky.
Palm, Isaac, Penn.
Palm, Jacob., Esopus, N. Y.
Pannebecker, Jesse, Elizabeth Township, Pa., since about 1820, sometimes spelled, Pennypacker.
Pannebecker, William, ——— Pa.
Palmer. ?
Perkins, Joseph, Phila., Penn., about 1800.
Remington, Eliphalet 2d, Ilion, N. Y., began 1816.
Reynolds, Lancaster, Penn.
Richardson, Joel, Boston, Mass., 1816 to 1825.
Rupp, J., Penn.
Ruslin, Jacob.
Schnaut, T. G., Monmouth, N. J., d. 1838.
Schull, M. ?
Schultz. ?
Schaeffer, ?
Shell, John, Penn. ?
Shell, N., Penn. ?
Snell, Elijah, Auburn, N. Y., d. 1834.
Smith, M. ?
Smith, Obadiah, Brunswick County, Va., before about 1820.
Spang & Wallace, Phila., Penn
Speed, Robert, Boston, Mass., after 1818.
Spies, A. W., N. Y., N. Y., b. abt. 1783; d. abt. 1863.
Spitzer, Jr., Newmarket, Va., until about 1825.
Starr, Lancaster, Penn., b. and a. 1800.
Starr, Nathan, Middletown, Conn., about 1790 to about 1850.
Tell, Frederick, Penn. ?
Thompson, John, Phila., Penn., about 1800.
Tryon, Geo. W., Phila., Penn., 1811 to 1836.
Tryon & Getz, Phila., Penn., 1811 only.
Wallach, Moses A., Boston, Mass., 1800 to about 1825.
Walters, A., N. Y., N. Y., b. and a. 1822.
Ware & Morse, (Jos. S., John R.), Worcester, Mass., began 1833.
Ware & Wheelock, Worcester, Mass., began 1825.
Watson, Jonathan, Chester, N. H., b. and a. 1800.
Whall, William, Jr., Boston, Mass., 1813 to 1819.
Whittemore, Amos, Boston, Mass.

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Wickham, Marine T., Phila., Penn.
Wolf, N. Y., N. Y.
Wood, Luke, Sutton, Mass.
Wright, J., ? b. and a. 1815.

CAP LOCK PERIOD, SPORTING RIFLES

Abbey, George T., Chicago, Ill., b. and a. 1860.
Alberston, Douglas & Co., New London, Conn., about 1840 to 1860.
Allen, C. B., Springfield, Mass., b. and a. 1836.
Allen, Ethan, Grafton, Mass.
Allen, G. F., Utica, N. Y., b. and a. 1850.
Allen, Henry, N. Y., N. Y.
Allen, Oliver, Norwich, Conn.
Allen, William, N. Y., N. Y.
Allen, Brown & Luther, Worcester, Mass. (Ethan Allen).
Allen & Falls, Springfield, Mass., about 1830.
Allen & Thurber, Grafton, Mass., 1837 to 1842
Norwich, Conn., 1842 to 1847
Worcester, Mass., 1847 to 1856
} (Ethan Allen)
Allen & Wheelock, Worcester, Mass. (Ethan Allen).
Amsden, B. W., Saratoga Springs, N. Y., b. and a. 1850.
Annely, John, N. Y., N. Y.
Anschutz, E., Phila., Pa.
Armstrong, John, Jr., Gettysburg, Penn., b. and a. 1855.
Armstrong, S. F., Adamsville, Mich.
Avery, Willis, Salisbury, N. Y.
Babcock, Moses, Charlestown, Mass.
Baird, S. S., Chittenden, Vt.
Bandle, J., Cincinnati, Ohio.
Bandle Gun Co., Cincinnati, Ohio.
Barker, Cyrus, Providence, R. I.
Bartlett Bros., Binghampton, N. Y., about 1825 to 1850.
Beadle, Indian Trail, Ohio, about 1840 to 1890.
Beauvais, R., St. Louis, Mo.
Bekeart, San Francisco, Calif.
Berry, W., Poughkeepsie, N. Y., b. and a. 1840. Later, Albany.
Berstro, J. H., Buffalo, N. Y., b. and a. 1835.
Beutter Bros., New Haven, then Meriden, Conn., b. and a. 1850.
Biddle, T. and W. C., Phila., Penn.
Billinghurst, William, Rochester, N. Y., from about 1830 to death in 1880.

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Bird, John, Oskaloosa, Iowa, from about 1860 to about 1900. Died 1918, aged 86.
Bisbee, D. H., Norway, Me., about 1835 to 1860.
Bisbing, Penn.
Bishop, Henry H., Boston, Mass., b. and a. 1847.
Bishop, William, Boston, Mass., 1818 to about 1860.
Blake, E. ?
Blunt, Orison, N. Y., N. Y.
Blunt & Syms, N. Y., N. Y., 1837 to about 1865 (Orison Blunt)
Booth, Ottawa, Canada.
Boyer, D., Penn.
Boyington, John, S. Coventry, Conn.
Brand Arms Co., Norwich, Conn., about 1840–1860.
Brockway, Norman S., W. Brookfield, Mass.
Brown, Andrew, Fremont, then Poplin, N. H. (son of John, below).
Brown, C. E. ?
Brown, F. P., Lancaster, Penn.
Brown, John, Poplin, N. H., 1840 to 1857; Fremont, 1857 to 1870.
Brown, J. F., Haverhill, Mass.
Brown & Sons, William, Pittsburg, Penn.
Buck, H. A., & Co., W. Stafford, Conn.
Burdick, S. ?
Burkhard, William R., St. Paul, Minn.
Buswell, J., Glens Falls, N. Y.
Cartwright, John, Ottowah, Ohio, b. and a. 1865.
Chapple, Thomas, N. Y., N. Y.
Chase, Anson, Hartford, Conn., 1830 to 1834; New London later.
Chase, William, Pandora, Ohio, b. and a. 1860.
Cherrington, Penn.
Chilcote, Penn. ?
Clark, Carlos, Windsor, Vt. Claimed inven. false muz. in 1836, wh. was patented by Alvan Clark (brother?), celebrated telescope maker, in 1840.
Clarke, N., ——— Penn. ?
Cochran, John W., N. Y., N. Y.
Coleman, H., Boston, Mass., b. and a. 1847.
Colt Patent Fire Arms Co., Hartford, Conn., beginning 1848.
Constable, Richard, Phila., Pa.
Cooper, Henry T., N. Y., N. Y., b. and a. 1845.
Craig, William, Allegheny, Penn., b. and a. 1850.

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Crandall, W. F., Gowanda, N. Y.
Crissey, Elias, ——— Penn. ?
Cushing, A. B., Troy, N. Y., about 1840–1870.
Davidson, F., & Co., Cincinnati, Ohio, b. and a. 1850.
DeLaney, Sussex County, N. J.
Deringer, Henry, Phila., Penn., born 1786, died 1868.
Derr, John, Lancaster, Penn.
Dewarson, R., Boston, Mass., b. and a. 1847.
Dimmick, H. E., St. Louis, Mo., b. and a. 1850.
Dish, R., ———? N. Y.
Dooley, Scranton, Penn.
Douglass, ——— Penn. ?
Dunlap, G., ——— ? Penn., Prop. Pennsylvania Rifle Works.
Dwight, H. D., Belchertown, Mass., b. and a. 1847.
Eaton, J., Boston, Mass., b. and a. 1847.
Eaton, J., Concord, N. H., about 1870 to about 1916.
Edgerton, H. S., German, N. Y.
Eggers, Samuel, New Bedford, Mass., about 1840 to 1865.
Ensley, M. ?
Estabrook, J. M., Milford, Mass.
Estabrook, Wm. W., Armada, Mich.
Fairbanks, A. B., Boston, Mass., died 1841.
Farrington, William B., Concord, N. H.
Ferris, George H., Utica, N. Y., about 1850–1875.
Fischer, Gustav, N. Y., N. Y., b. and a. 1860.
Fish, N. Y., N. Y., b. and a. 1845.
Fogg, G. E., Manchester, N. H.
Folsom, Henry, & Co., St. Louis, Mo.
Foster, George P., Taunton, Mass.
French, Thomas, Canton, Mass., born 1778; died 1862.
Fry, Francis, Doniphan County, Kans., b. and a. 1855.
G., D. & Co., Cincinnati, Ohio.
Gable, H. ?
Gardner, J. N., Scranton, Penn.
Gemmer, John P., St. Louis, Mo., 1862–1915; previously a Hawken employee, died 1919.
Gibbs, Tiffany & Co., Sturbridge, Mass., about 1820–1850.
Gilbert, E., Rochester, N. Y.
Glassbrenner, H. ?
Golcher, James, Phila., Penn.
Golcher, John, N. Y., N. Y.
Gompf, Penn.
Goulcher, George, N. Y., N. Y.

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Goulcher, Joseph, Penn. Late Flint through perc'n.
Grainger, Toronto, Canada.
Great Western Gunworks, Pittsburg, Penn. See James H. Johnston.
Gross, Tiffin, Ohio, about 1840–1880.
Groot, Henry, Pittsfield, Mass.
Grover & Lovell, Boston, Mass., 1841 to 1844 (John P. Lovell).
Gubb, George, N. Y., N. Y.
Hahn, W., N. Y., N. Y.
Hall, Alexander, ——— ? N. Y., b. and a. 1850.
Hall, E. L., Springfield, Mass.
Hapgood, Joel, Shrewsbury, Mass., born about 1805; died about 1890.
Harden, J., Lock Haven, Penn.
Harrington. H. B., Lebanon, N. H.
Harrington, Luke, Sutton, Mass., b. and a. 1832.
Hart, B. J., & Bro., N. Y., N. Y.
Harwood, Nathaniel H., Brookfield, Mass., about 1825–1840.
Hatch, Warren, Plattsburg, N. Y., b. and a. 1850.
Hawken, Jacob (son of Henry Hawkins), St. Louis, Mo., 1820 to 1849; born Hagerstown, Md., 1786; died May 9, 1849. Celebrated.
Hawken, Samuel T. (son of Henry Hawkins) born Hagerstown, Md., Oct. 26, 1792; St. Louis, Mo., 1822 to 1860; Independence, Iowa; Denver, Colo.
Haynes, Joshua, Waltham, Mass.
Henry, Granville, Boulton, Penn.; Phila. Penn., 1835 to 1912.
Henry, J., & Son, Boulton, Penn.; Phila., Penn.
Hepburn, Lewis L., Colton, Vt., inventor of Remington-Hepb. action.
Hetrick, I. (or J.), & Co. ?
Hilliard, D. H., Cornish, N. H.
Hobbs, P., Monterey, Mass.
Horn, C., ——— ? Penn., about 1820–1855.
Houghton, Richard W., Norway, Me.
Howland, Rufus J., Binghampton, N. Y., about 1840–1870.
Hudson, W. L., Cincinnati, Ohio.
Humbarger, Adam, Somerset, Ohio.
Hyde & Goodrich, New Orleans, La.
Ingall, Brown, Portland, Bucksport, Andover and Blue Hill, Me.
James, Morgan, Utica, N. Y., about 1820–1860.
Johnston, James H., Pittsburg, Penn., Prop. Great Western Gunworks. Born 1836; died about 1916; business 1866 to 1915. Son of John.

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Johnston, John H., Waynesboro, Penn., born, 1811; died, 1889.
Jordan, L., S. Adams, Mass.
Kellogg Bros., New Haven, Conn., about 1850–1890.
Kemmerer, David, Carbon County, Penn.
Kemmerer, David, Jr. ——— ?
Kendall, N., Windsor, Vt., b. and a. 1850.
Kessler, John, Weston, Mo., about 1840–1860.
Kittinger, J., ——— ?
Klein, P. H., N. Y., N. Y.
Krammer, ——— ? Penn.
Krider, John, Phila., Penn., about 1820–1870.
Lancaster Rifle Works, Lancaster, Penn.
Lander, C., ——— ?
Lane & Read, Boston, Mass., 1826 to about 1835.
Latil, L. A., Baton Rouge, La.
Lawrence, Laconia, N. H.
Lawrence, Richard S., Hartford, Conn.
Lee Arms Co., Milwaukee, Wis.
Leman, Henry E., Lancaster, Penn., born, 1812; died, 1887. Began for himself 1834. Son of H. E. Former spelling Lehmann.
Leonard, A., & Sons, Saxons River, Vt., about 1840–1860.
Lewis, Troy, N. Y.
Libeau, V. G. W., New Or'eans, La., b. and a. 1835.
Lindsay, John Parker, ——— ?
Livermore, E. K., ——— ? N. Y.
Losey, B., ——— ?
Lovell, John P., Boston, Mass., born, 1820; died, 1897. Business 1844 to 1887.
Lower, John P., Phila., Penn., before 1872. Denver, Colo., 1872 to 1915. Born, 1833; died, 1915.
Lupus, Dover, N. H.
Marker, Daniel, ——— ?
Marsh, J., Binghampton, N. Y., about 1850–1870.
Marston Firearms Co., N. Y., N. Y.
Marston, W. P., Toronto, Canada, b. and a. 1860.
Mass. Arms Co., Chicopee Falls, Mass., 1849–about 1880.
Maynard Gun Co., Chicopee Falls, Mass.
McComas, Alexander, Baltimore, Md.
Merritt, Allen, E. Randolph, Mass.
Messer, W. W., Boston, Mass.
Meunier, John, Milwaukee, Wis. Active about 1855; died, 1919.
Miller, C., Honoeye, N. Y.

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Miller, John, Penfield, later at Munroe, Mich., about 1830–1875.
Miller, M. ?
Miller, Simon (Jr.?), Hamburg, Penn.
Miller, S. C., New Haven, Conn., b. and a. 1850.
Miller, W. D., Pittsfield, Mass.
Moore, J. P., Union, N. Y., b. and a. 1845.
Moore, R. A., N. Y., N. Y.
Morse, Thomas, Lancaster, N. H., about 1866–1890.
Mullin, John, N. Y., N. Y., b. and a. 1850.
Mullin, Patrick, N. Y., N. Y., b. and a. 1850.
Nason, C. F., Auburn, Me.
Nelson & Co. ——— ?
Ogden, J., Owego, N. Y.
Ogden, W. E. Owego, N. Y.
Olmstead, Morgan L., Auburn, N. Y.
Overly, Peter, ——— ? Ky.
Pannebecker, Jesse, Elizabeth Township, Penn.
Parker, H., & Co., Trenton, N. J.
Parsons, Plattsburg, N. Y., b. and a. 1860.
Patent Arms Mfg. Co., Paterson, N. J., 1836 to 1842.
Pennsylvania Rifle Works, Penn. (G. Dunlap, Prop.).
Perry Pat. Arms Co., Newark, N. J. (Alonzo D. Perry, Prop.), about 1850–1858.
Perry, J. V., Jamestown, N. Y., b. and a. 1840.
Phillips, E., N. Y., N. Y.
Porter, Patrick W., N. Y., N. Y.
Potter, Daniel, Hartford, Conn.
Pratt, Alvan, Concord, Mass., at least as early as 1835.
Pratt, Henry, Roxbury, Mass., born, 1790; died, 1880.
Prissey, Elias, Hooversville, Pa., born, Oct. 25, 1835. Specialty, ornamented m. l. squirrel rifles.
Ramsdell, G. V., Bucksport, Me.
Read, William, Boston, Mass.
Rocketer, J. H., Syracuse, N. Y., b. and a. 1850.
Remington, Eliphalet, Ilion, N. Y.
Richardson, O. A., Lowell, Mass.
Riggins, Thomas, McMinn County, Tenn., born, 1821. Was living in 1910.
Riggs, B., Bellows Falls, Vt., b. and a. 1850.
Ripley Bros., Windsor, Vt., b. and a 1835.
Robbins, W. E., Manesburg, Penn.
Robbins, W. G. ——— ?
Roberts, W., Dansville, N. Y., b. and a. 1850.

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Roemer, O. E. ——— ?
Roger, J., Highland, Ill.
Rogers, R., ——— ? Calif.
Roth, Charles, Wilkes-Barre, Penn.
Rowe, A. H., Hartford, Conn.
Ruggles, Stafford Hollow, Conn.
Sargent & Smith, Newburyport, Mass.
Schaefer, William R., Boston, Mass. Began business 1853. Was living in 1917.
Schaefer & Werner, Boston, Mass., about 1860 to 1870. (William R. Schaefer.)
Schalk, Chris, Williamsport (?) Pa., about 1825–1875.
Schenkl, J. P., Boston, Mass. b. and a. 1850.
Schmelzer, J. H., Leavenworth, Kans.
Schneelock, Brooklyn, N. Y.
Scrivener, James A., Auburn, N. Y.
Seibert, Columbus, Ohio.
Senseny, Chambersburg, Penn., b. and a. 1855.
Seaver, Vergennes, Vt.
Sharps Rifle Mfg. Co., Hartford, Conn., 1848 to 1871; Bridgeport, Conn., 1871 to Oct. 1881. (Christian Sharps)
Shell, John, Liverpool, Penn.
Shields, D. ——— ?
Shuler, John, Liverpool, Penn.
Sieber, C. C., Columbus, Ohio.
Siebert, H. L., Cincinnati, Ohio.
Slocum, Harding, Worcester, Mass., began 1820.
Slotterbeck, Charles, Sr., San Francisco, Calif.
Smart, Eugene, Dover, N. H., about 1865–1890.
Smith, Horace, Springfield, Mass. Born, 1808. After 1856, of firm of Smith & Wesson.
Smith, Martin, Greenfield, Mass., b. and a. 1830.
Smith, P., Buffalo, N. Y.
Snell, Chauncey, Auburn, N. Y., about 1830 to 1860. Son of Elijah.
Soubie, Armand, New Orleans, La.
Spangler, G. ——— ?
Spencer, Dwight, W. Hartford, Conn.
Spies, A. W., N. Y., N. Y. Born about 1783; died about 1863.
Stuart, Charles, Binghampton, N. Y. about 1850–1870.
Sweet, E. S., Kalamazoo, Mich.
Taylor, Argulus, Ira, N. Y.
Thomas, Benjamin, Hingham, Mass., b. and a. 1845.

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Tidd, Marshall, Woburn, Mass. Died about 1890.
Tomes, Henry, & Co., N. Y., N. Y., b. and a. 1845.
Tonks, Joseph, Boston, Mass., b and a. 1860, at 49 Union st.
Trout, John. ——— ?
Tryon, George W., Phila., Penn., 1836 to 1843, including & Co., Son & Co.
Underwood, Thomas, Lafayette, Ind.
Vallee, Prosper, Phila. Penn., b. and a. 1840.
Vanderheyden, John, Auburn, N. Y.
Varney, David M., Burlington, Vt., b. and a. 1850.
Ware, J. S., Worcester, Mass.
Ware, Orlando, Worcester, Mass.
Warner, Horace, Ridgeway, Penn.
Warner, James, Springfield, Mass. Born, about 1818; died, about 1870.
Warner & Lowe, Syracuse, N. Y., b. and a. 1880 (Horace), (Wm. V.)
Waters, Asa H., Millbury, Mass., after 1813.
Waters, A., & Co., } Sutton, Mass.; Millbury, Mass., Asa, father of Asa H.
Waters, A., & Son }
Weaver, H. B., S. Windham, Conn.
Weiss, G., ——— ? Penn.
Wesle, N., Milwaukee, Wis.
Wesson, Stevens & Miller, Hartford, Conn., about 1848–1855. (Edwin), (Joshua), (S. C.)
Wesson, Daniel B., Worcester, Mass., Taunton, Mass. After 1856, Springfield, Mass., firm of Smith & Wesson.*
Wesson, Edward, Northboro, Mass., b. and a. 1840.
Wesson, Edwin, Hartford, Conn., Northboro, Mass.
Wesson, Frank, Worcester, Mass.
Whitmore, Andrew E., Somerville, Mass., b. and a. 1860.
Whitmore, H. G., Boston, Mass., beginning about 1853.
Whitmore, Nathan, Marshfield, Mass., about 1825–1880.
Whitney, Eli, New Haven, Conn., Whitneyville, Conn. Son of the inventor of the cotton-gin.
Whittemore, D., Cambridge, Mass., b. and a. 1860.
Williams, Abe, Covington, Ky. (?)
Wilmot, N. N., Boston, Mass.
Wood, B. C. Painted Post, N. Y.
Worthen, Barney, San Francisco, Calif.
Wrisley, Loren, H., Norway, Me., began business 1834.
Yesley, H. ——— ?

* Daniel, Edwin, and Frank Wesson were brothers; Edward was a cousin.

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METALLIC CARTRIDGE PERIOD, SPORTING RIFLES

Adirondack Arms Co., Plattsburg, N. Y., about 1870–1875.
Adolph, Fred, Genoa, N. Y. Present.
Allen, E., & Co., Worcester, Mass., defunct about 1880. (Ethan.)
Allen & Wheelock, Worcester, Mass., 1856 to 1865. (Ethan Allen.)
American Rep. Rifle Co., Boston, Mass., defunct in 1869.
Bay State Arms Co., Uxbridge, Mass., about 1870–1875.
Bouron, P., New Orleans, Ia.
Brockway, Norman S., Bellows Falls, Vt., W. Brookfield, Mass. Born about 1855.
Brown Mfg. C., Newburyport, Mass.
Bullard Rep. Arms Co., Springfield, Mass., and Boston, Mass. Defunct.
Carver, James W., Pawlet, Vt., b. and a. 1885.
Conn. Arms & Mfg. Co., Naubec, Conn., specialty, Hammond rifles. Defunct.
Crow, C. A., Lima, Ohio., b. and a. 1870.
Davenport, W. H., Fire Arms Co., Norwich, Conn., about 1855–1910.
Doell, Frederick, Boston, Mass., 1884 to 1909. Son, successor, at 11 Dock Sq., does not manufacture.
Evans Rep. Rifle Co., Mechanic Falls, Me., defunct.
Farrow Arms Co., Holyoke, Mass., about 1885–1890, then moved to Mason, Tenn. Defunct.
Farrow, Wm. Milton, Holyoke, Mass., about 1880–1885.
Fogerty Rep. Rifle Co., Boston, Mass., defunct about 1868.
Fortune, Thomas L., Mt. Pleasant, Kans.
Gove, Carlos, Denver, Colo., deceased.
Great Western Gun Works, Pittsburg, Penn.
Harrington & Richardson, Worcester, Mass., past and present.
Harwood, Reuben, Somerville, Mass., deceased.
Henry Repeating Arms Co., New Haven, Conn. Ceased 1866.
Holden, C. B., Worcester, Mass., deceased.
Holmes, George H., Defiance, Ohio, b. and a. 1870.
Hopkins & Allen Co., Norwich, Conn., defunct.
Howard Bros., Whitneyville, Conn., deceased.
Hulbert Bros. & Co., ——— ? deceased.
Kirkwood, David, Boston, Mass., deceased; successors, 23 Elm St., do not manuf.
Lee Firearms Co., Milwaukee, Wis.
Lovell, J. P., Arms Co., Boston, Mass. Succeeded by the Iver Johnson Co., which does not manuf. rifles.

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Lowe, William V., Fitchburg, Winchester, Woburn, Mass., about 1875–1895.
Marble Arms & Manuf. Co., Gladstone, Mich., .22 only. Present.
Marlin Fire Arms Co., New Haven, Conn. Past and present.
Mass. Arms Co., Chicopee, Mass. Defunct.
Merrimac Arms & Mfg. Co., Merrimac, Conn. Defunct.
Merwin & Bray, N. Y., N. Y. Defunct.
Meunier, Steven, Milwaukee, Wis. Present.
New Haven Arms Co., New Haven, Conn. 1860 to 1866.
Niedner, A. O., Melrose, Mass. Present; few.
Pachmeyer, ——— Los Angeles, Calif. Present; few.
Patt, C., Alma, Wis. Deceased.
Petersen, A. W., Denver, Colo. Present.
Pope, Harry M., Hartford, Conn., to 1901; present address unknown. Very skilful.
Providence Tool Co., Providence, R. I., about 1850–1917.
Quakenbush, H. M., Deferiet, N. Y., small rifles only.
Quinnebaug Rifle Co., Southbridge, Mass. Defunct.
Remington, with various prefixes and terminations, Ilion, N. Y. Past and present.
Rice, Ralsa C., ——— ? Ohio., born 1838; died, 1911.
Roper Repeating Rifle Co., Amherst, Mass. Defunct.
Rowell, Horace, Sawmill Flats, Calif. Deceased ?
Savage Arms Co., Utica, N. Y. Present.
Schalch, George, Pottsville, Penn., b. and a. 1885.
Schoyen, George, ——— ? N. Y. Present; few.
Sharps & Hankins, Phila., Penn. Defunct about 1880.
Sharps Rifle Co., Bridgeport, Conn. Defunct Oct., 1881.
Shirley, Jeremiah, Cloverdale, Ohio, b. and a. 1870.
Slotterbeck, Charles, Jr., Calif. Deceased ?
Slotterbeck, H., Los Angeles, Calif.
Smith & Wesson, Springfield, Mass. Only hand arms now.
Spencer Rep. Arms Co., Boston, Mass. Defunct about 1870.
Stalter, William, Logan, Ohio., b. and a. 1870.
Stevens, J., Arms & Tool Co., Chicopee Falls, Mass. Past and present. Now the Westinghouse Co. To unite with Savage Co.
Thorsen, Thomas M., Phila., Penn. Deceased ?
Trant, George B., Thornville, Ohio., b. and a. 1880.
Tryon, Phila., Penn. With various prefixes and suffixes, past and present.
Volcanic Rep. Arms Co., New Haven, Conn., 1855 to 1857.
Warner, Horace, Williamsport, Penn., about 1890.
Webber Arms Co., Denver, Colo. Does not manufacture now.

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Wesson, Frank, Springfield, Mass. Deceased.
Whitney, Eli, Whitneyville, Conn. Ceased 1888.
Wilkinson, J. D., Plattsburg, N. Y. A few, 1866 to now.
Winchester Rep. Arms Co., New Haven, Conn., 1866 to now.
Wundhammer, Ludwig, Los Angeles, Calif. Modern, a few.
Wurfflein, William, Phila., Penn., about 1875–1910.
Zettler Bros., N. Y., N. Y., about 1880–1900.
Zischang, Syracuse, N. Y. Modern, a few.

MILITARY RIFLE SPECIALISTS

PAST AND PRESENT

Am. Arms Co., Chicopee Falls, Mass., Civ. War; Smith carbines.
Am. Machine Wks., Springfield, Mass., Civ. War, Smith carbines.
Ames, N. P., Co., Springfield, Mass. Mex. & Civ. War rifles; Jenks carbines & rifles.
Amoskeag Mfg. Co., Manchester, N. H. Civ. War, 27001 rifle mus.
Ballard Arms Co., Fall River, Mass. Civ. War Ballard arms.
Brooks, William F., N. Y., N. Y. Civ. War, Gibbs carb.
Brown Mfg. Co., Newburyport, Mass. Brown rifles. Ballard rifles.
Burnside Rifle Co., Providence, R. I. Burnside carb.
Burt, A. M., ——— ? Civ. War, 11495 ri. mus.
Colt, Pat. F. A. Co., Hartford, Conn. (Civ. War, 75,000 ri. mus., and various past and present.)
Cosmopolitan Arms Co., Hamilton, Ohio. Civ. War, Cosmopolitan carb.
Driggs-Seabury Ordn. Co., Utica, N. Y. Temporary, wartime, successor to Savage Arms Co. Modern.
Eagle Mfg. Co., Mansfield, Conn. Civ. War 20,000 ri. mus. marked "Eagleville."
Ellis, Reuben, Albany, N. Y. 500 Hall b. l. rifles in 1829.
Evans Rep. Rifle Co., Mechanic Falls, Me., about 1871 to about 1880.
Gwyn & Campbell, Hamilton, Ohio. Civ. War, Cosmop. carbines.
Hall, John H., N. Yarmouth, Mass. (now Me.), until 1816; Harpers Ferry Armory, W. Va., 1816 to 1840; died in Mo. 1841. Inventor and maker of Hall b. l. flint and cap arms.

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Harpers Ferry Armory, W. Va., A U. S. Gov't. arms manufactory from 1796 until its destruction in 1861.
Hoard, C. B., Watertown, N. Y. Civ. War, 12,800 ri. mus.
Hodge, J. T., ——— ? Civ. War, 10,500 ri. mus.
Hopkins & Allen, Norwich, Conn. Modern only.
Jenks, Alfred, & Son, Bridesburg, Penn., Civ. War, 98,000 ri. mus. and Needham conversions.
Johnson, Robert, Middletown, Conn. Model 1819 rifles.
Joslyn, B. F., Firearms Co., Stonington, Conn. Civ. War and later Jos. carb.
Lamberson & Furman, Windsor, Vt. Model 1841.
Lamson, Goodnow & Yale, Windsor, Conn. Civ. War. 50,000 ri. mus. marked " L. G. & Y."
Lamson, E. G., Windsor, Vt. Palmer, Ball, and other Civ. War arms.
Langdon, W. G., Boston, Mass. Civ. War " Snipper " rifles only.
Lee Arms Co., Milwaukee, Wis. Civ. War Lee carb.
Marlin-Rockwell Co., New Haven, Conn. Successor to Marlin Arms Co. Modern.
Mason, William, Taunton, Mass. Civ. War, 30,000 ri. mus.
Mass. Arms Co., Chicopee Falls, Mass. Civ. War, Maynard ri. and carb.
Maxim Munitions Co., New Haven, Conn. Modern.
Maynard Gun Co., Chicopee Falls, Mass. Early Civ. War Maynard carb.
Meriden Mfg. Co., Meriden, Conn. Civ. War., Triplett & Scott and other arms.
Merrill, J. H., Baltimore, Md. Civ. War, Merrill carb.
Midvale Steel & Ordn. Co. ——— ? Modern.
Milholland, James. ——— ? Civ. War, 5,502 ri. mus.
Mowry, D. D. ——— ? Civ. War, 22,000 ri. mus.
Muir, William, Windsor Locks, Conn. Civ. War, 30,000 ri. mus.
New Haven Arms Co., New Haven, Conn. Civ. War, Henry rep. rifles.
Norris, S., & W. T. Clement ——— ? Civ. War, ri. mus. marked " S. N. & W. T. C. for Mass."
North, Simeon, Middletown, Conn. Models 1817, '19. Repeating flintl. for militia. Hall carb.
Norwich Arms Co., Norwich, Conn. Civ. War 25,000 ri. mus.
Parker, Snow & Co., Meriden, Conn. Civ. War, 15,000 ri. mus.
Prov. Tool Co., Providence, R. I. Civ. War, 70,000 ri. mus.; later, Peabody, and Peabody-Martini.

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Remington, E., Ilion N. Y. From Mex. War to now the most varied lot of any Am. firm. Now named the Remington-U. M. C. Co.

Richardson & Overman, Phila., Penn. Civ. War, Gallager carb.

Robbins & Lawrence, Windsor, Vt. Mex. & Civ. War, various.

Robinson, Edward, N. Y., N. Y. Civ. War, 30,000 ri. mus.

Rock Island Arsenal, Rock Island, Ill. U. S. Gov't. arms manuf. since 1843.

Ross Rifle Co., Quebec, Canada. Modern.

S. N. & W. T. C., see Norris.

Sarson & Roberts ——— ? Civ. War, 5,140 ri. mus.

Savage Arms Co., Utica, N. Y. Modern.

Savage, R. F. A., Co., Middletown, Conn. Civ. War, 25,500 ri. mus.

Schubarth, C. D. ——— ? Civ. War, 9,500 ri. mus.

Sharps & Hankins, Phila., Penn. Civ. War, S. & H. ri. and carb.

Sharps Rifle Co., Hartford, Conn. Civ. War Sh. ri. and carb.

Spencer Rep. Arms Co., Boston, Mass. Civ. War Spenc. ri. and carb.

Springfield Armory, Springfield, Mass. U. S. Gov't. manuf. of arms since 1895; of rifles since 1819.

Starr Arms Co., Yonkers, N. Y. Civ. War. Starr carb.

Starr, Nathan, Middletown, Conn. Model 1817 rifles.

Trenton Arms Co., Trenton, N. J. Civ. War, ri. mus.

Tryon, Phila., Penn. Model 1841.

Warner, James, Springfield, Mass. Civ. War and later Warn. carb.

Welch, W. W. ——— ? Civ. War, 17,000 ri. mus.

Wesson, Frank, Worcester, Mass. Civ. War, a few carb.

Westinghouse, Chicopee Falls, Mass. Modern. Formerly the J. Stevens Co.

Whitney, E., Whitneyville, Conn. Model 1841, Civ. War, 15,001 ri. mus. and many later.

Winchester R. A. Co., New Haven, Conn. Many since 1866. Modern.

Under " Rifles Used Against the U. S." there is a list of Confederate manufacturers.

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